

# SOCIAL AND ECONOMIC STUDIES

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INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH  
UNIVERSITY COLLEGE OF THE WEST INDIES, JAMAICA, B. W. I.

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## **SOCIAL AND ECONOMIC STUDIES**

**Social and Economic Studies** reports on the work undertaken by or in association with the Institute of Social and Economic Research but other contributions will be considered.

**H. D. Huggins — Editor**

**VOL. 1, NO. 2**

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**UNIVERSITY COLLEGE OF THE WEST INDIES, JAMAICA, B.W.I.**

## INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH

UNIVERSITY COLLEGE OF THE WEST INDIES

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## TWO STUDIES IN JAMAICAN PRODUCTIVITY

By  
G. E. CUMPER

### 1. SOME PRODUCTIVITY COMPARISONS AND THEIR SIGNIFICANCE

There are many societies in the world today with lower national incomes per head of population than the British West Indies, but there are few in which the level of national income is a more urgent problem, and few in which the idea of national poverty is so consciously entertained by the average man. A majority of the populations in the larger territories have acquired by observation of the urban middle class a detailed knowledge of the material standards of life associated with incomes on the European or North American scale; an important minority of families includes some member, who, as a temporary or permanent emigrant to Europe or America, has actually enjoyed these standards. The institutional forces which formerly hindered the West Indian worker from aspiring to the material standards of a class not his own are gradually weakening, and in its various forms the conflict between the high standard of material consumption that is desired, however vaguely and unpurposively, and the low standard of current output recurs in all the branches of West Indian life.

There is a tendency in current West Indian opinion to identify the solving of the problem of poverty with the raising of the level of productivity. This tendency is partly a healthy reaction against certain traditional attitudes which, by emphasising the dependent nature of the economies of the West Indian territories, have stultified attempts to initiate economic development by local action. In so far as it represents a recognition of the important general connection between productivity and the standard of life the tendency is an advance. Sometimes, however, the argument is put in an extreme form which implies either that no increase in the standard of living can take place without a prior increase in productivity, or that any increase in productivity necessarily leads to a rise in the standard of living. These statements are open to objection on two grounds. First, the terms 'standard of living' and 'productivity' are susceptible of several definitions. Second, even where these terms have been satisfactorily defined there are cases in which the connection between them breaks down, and these cases are of practical importance in the West Indian context.

This discussion is an exploration of the relation between changes in 'productivity' in an economy like that of Jamaica, as measured in certain ways, and changes in the standard of living. The possible ramifications of such a discussion are so wide that no attempt is made here to explore the various possible meanings of the term 'standard of living', which is defined arbitrarily as the national consumption income per head of population on some standard price basis. Such a definition

abstracts from some important elements in the total situation which might be held to be part of the standard of living in a wide sense. In particular it takes no account of changes in culture and social organisation which, it can be argued, necessarily accompany certain types of changes in productivity; and, within the field of economics proper, it makes no allowance for changes in income distribution.

In one of its senses productivity may be defined as the national product per head of population, on some standard price basis. Such a definition reduces the possibility of divergence between changes in the standard of living and changes in productivity to a minimum, but the discrepancies which may remain are important. In the Jamaican context such a discrepancy may arise through changes in the terms of trade. A rise in the price of export crops not accompanied by a proportionate rise in the price of imports may lead to an increase in national income per head without any increase in production per head on a physical or standard-price basis. A similar discrepancy could also conceivably arise from fluctuations in investment or from overseas borrowing, but the relative stability of Jamaican domestic investment and the nature of the Jamaican system of banking and note issue make it unlikely that this point is practically important. Generally speaking, on the definitions given above changes in productivity and in the standard of living can only diverge in an economy in which imports and exports play a considerable role, and the extent of the divergence will be the greater the smaller the share the economy has in the relevant world markets and the greater the extent of the imperfection in those markets.

If we define productivity not as the national income per head of the total population but as the national income per head of the gainfully occupied population we introduce another possibility of divergence between the standard of living and productivity, since the ratio of the gainfully occupied to the total population can undergo considerable changes. Such a change may come from demographic causes. For example, a population studied at a time when it is passing through a period of peak fertility will have a higher proportion of dependents and a lower ratio of working-age to total population than the same population a generation later, other things being equal. If the same proportion of the population of working age is gainfully occupied in each case, and if the level of productivity is the same, then the earlier population will have the lower standard of living. It is possible that in such a case the proportion of the population of working age who are gainfully occupied will adjust itself in such a way as to reduce the divergence between productivity and standard of living. For example, the proportion of housewives who are gainfully occupied may decrease; this will lower the standard of living which, on the above definitions, corresponds to a given level of productivity. There does not seem to be sufficient evidence to say to what extent such adjustments take place in fact, but it is doubtful whether they can cancel the primary effects of a change in age structure.

A second type of divergence occurs when we consider the employed population rather than those available for employment. An increase in productivity among those in work, together with a decrease in their numbers, need not lead to an increase in the standard of living. That this is true as a formal proposition can hardly be questioned; the more important point is whether such a conjunction is likely to occur in practice. The following is a case which may arise in the Jamaican context. A staple agricultural industry is supposed to change its production methods so that the number employed and the total wage bill is reduced but the productivity and income of those remaining in work is increased. The quantity and value of the product is assumed to remain unchanged. In the general circumstances of the Jamaican economy, what is the probable effect on the standard of living of the whole population?

While this case is broadly analogous to the classical cases of unemployment arising from technical progress and the substitution of capital for labour, the outcome of such a change in production methods will be affected by particular circumstances. Of the total value of production of the industry, which is assumed unchanged, a larger proportion than before will go to costs other than wage costs, and this is likely to reduce the value of the incomes accruing to persons within the island. We have to reckon, therefore, with a probable initial fall in national consumption. This, however, will find an offset in so far as the labour displaced by the innovation finds productive employment elsewhere. There are three main mechanisms by which the employment of the displaced workers can be brought about. The first is by a lowering of the supply price of labour. In a country like Jamaica where there are fairly strong institutional obstacles to a lowering of wage rates it does not seem likely that this mechanism will produce practically important results particularly as unemployment is already high. The second agency is a general rise in the marginal efficiency of labour, such as might be brought about by a series of innovations. Innovation is used here to mean not only decisive inventions involving major changes in production and consumption, but also minor improvements in processes and the gradual permeation of the economy with higher standards of technical and managerial competence. While such a process is certainly in operation in Jamaica today, its effect must be in practice considered along with the countervailing factor of population increase, and the net effect on the employment situation will depend on the quantitative importance of the two factors. The third agency to be considered is governmental subsidisation or protection of new industries or of the expansion of old industries, which may be looked on in this context as a manipulation of the relation between the marginal efficiency of labour and its supply price. Public opinion in the West Indies tends on this issue to take one of two extreme positions. One position is that of the extreme 'liberal' economist who adheres to the *a priori* argument that any distortion of that production pattern produced by the free operation of the market is likely to reduce welfare. The other position

accepts as desirable any intervention which results in the employment of those who had formerly been unemployed. In so far as the latter position is based on a social value attaching to employment *per se*, as distinct from the values created by that employment, it cannot be criticised in purely economic terms. But in so far as it rests on the addition to national production to be attributed to industries called into being by subsidisation, the argument needs qualification. Whether a subsidised industry represents a net addition to national production depends on the quantitative evaluation of a complex set of factors, including the amount of subsidy and the incidence of the taxes out of which it is furnished.

If, therefore, a change in production methods in a given industry leads to a reduction in the number employed in the industry and to a rise in the productivity of those so employed it is possible in the Jamaican setting that the standard of living will not rise and in specially unfavourable circumstances it may fall.

If we are considering a change of the same type not as occurring in an isolated industry but as occurring over a considerable part of the economy and as a long term process, we must take into account indirect effects of quite a different order. In Jamaica today there is in the agricultural industry a trend toward a higher productivity from a static or slowly contracting labour force (8). It would appear from the history of other societies that such a trend may be associated with a considerable social reorganisation, involving a concentration of the population in towns and cities, and an economic reorganisation, with much greater emphasis on secondary and tertiary production; and that, given favourable conditions, the process becomes self-maintaining and may continue until the society has progressed to higher levels of general productivity. The two processes mentioned as characteristic of such transitions, urbanisation and the growth of secondary and tertiary industries, are active in Jamaica. But in view of the considerable differences between Jamaica and the countries where such a transition has run its full course, it would require a bold extrapolation to predict that the results in that island will be the same as elsewhere. If we do accept such an extrapolation, however, it follows that increases in productivity which cannot be shown to increase the national income immediately may nevertheless be desirable as parts of a general process whose long-run effects are likely to be beneficial. The correspondence between changes in productivity and changes in the standard of living is therefore likely to be closer in the long run than in the short run.

A third common definition of productivity relates to the individual establishment rather than to the whole economy. On this basis productivity is measured by the ratio of the value of the product of the establishment, either gross or net of material costs, to the number of workers employed. In this sense the productivity of an individual establishment is very loosely linked to the general standard of living, being affected by the peculiarities of the establishment's economic

situation such as market fluctuations, labour disputes and the quality of entrepreneurship involved. Computation of the productivity on a standard price basis will not remove all these 'local' influences. Much of what was said above of the effects of increased productivity in a given industry can be applied also to the case of increased productivity in a single establishment; it is possible for productivity to rise in one or a few establishments without a rise in the standard of living, and it is theoretically possible for this to happen even when productivity rises in all establishments, but in practice a general rise in productivity on an establishment basis will be accompanied by a rise in the standard of living, and this will be more nearly true in the long than in the short run.

Where the output of an establishment is sufficiently homogeneous the ratio of the physical measure of the final output to the number of workers can be used as a measure of productivity. In measuring changes in output of the establishment over time this is equivalent to the gross value productivity on a standard price basis. It has special advantages when comparisons are to be made between different establishments in different economies.

There are broadly speaking two kinds of significance which are commonly ascribed to measures of productivity. From one point of view they can be seen as representing the overall effectiveness with which the factors of production are combined in a given productive unit; from another point of view they represent the quality of the single factor, labour. In practice the definitions of productivity given above yield information on both these aspects together, and it is misleading to speak of measures of these types as measures of 'labour productivity', with the implication that they yield information on the quality of labour independently of the efficiency with which that quality is put to work. They may, however, be considered as measures of labour productivity in a more limited sense, namely, as measures of the total productivity of the unit expressed in relation to the quantity of the single factor, labour, involved. Such a measure has no more theoretical importance than a similar measure of productivity related to the quantity of capital, land or entrepreneurship involved. But it has a greater practical convenience than these, since a manhour, manweek or manyear is an easier concept to handle than a 'unit' of entrepreneurship or even of capital. It has the further advantage that where productivity is to be considered in relation to the standard of living or some other measure of general consumption which is calculated on a *per capita* basis, the expression of productivity on an analogous basis makes clear certain simple relations between the two. The above discussion has shown that these relations are closer when the measure of productivity used is a general one relating to the whole economy as a unit rather than when smaller units are considered; it is in the more general case, therefore, that productivity per unit of labour can be most usefully employed as a measure to be compared with consumption *per capita*. But it is in this case also

that production per unit of labour throws least light on the quality of labour considered in isolation. It is necessary, therefore, to distinguish with some care the two senses in which a measure of *per capita* production may be said to be a measure of 'labour productivity'.

There is a further type of productivity measure based on output per unit of labour which reduces to a minimum the elements other than the mere quality of labour; such measures are based on output per unit of time in a standard operation. Even here, however, it is seldom possible to secure such a degree of standardisation that comparisons over extended periods of time do not include other elements than the essential qualities of the worker. It is this type of measure which is most characteristically a measure of 'labour productivity' in the first of the senses mentioned above.

This discussion has been couched in terms of changes in productivity and in standards of living over time. Another use of the measures described is in comparisons of these quantities from one economy to another. The arguments given above on the possibility of divergence between changes in these quantities and the distinctions drawn between types of productivity measurement can be applied without much modification to comparisons between economies. In the latter case, however, greater importance attaches to difficulties of valuation, since the fact that outputs are estimated in terms of different currency systems raises difficulties which are not completely overcome by the use of such a device as Clark's 'International Units'. More fundamental difficulties arise if one takes into account variations in importance from culture to culture of values which do not find a direct expression in computations of national income. The type of productivity statistic most commonly applied to comparisons between economies is the physical product per worker on an establishment or industry basis (e.g. Rostas (13) ).

There are few countries in which the published statistical material is copious enough to make it easy to calculate accurate and up to date figures of productivity. In Jamaica the only years for which the material approaches adequacy are 1943 and 1946. In 1943 a general census was taken which obtained information on occupations, earnings and employment much more complete and reliable than had been available before (3). This census, together with the lists of controlled prices and margins imposed during the war and with other material obtained *ad hoc*, was used by the Bureau of Statistics to make a detailed estimate of national income for 1943 (4). In 1946 the Bureau attempted to carry out a census of manufactures, but the coverage obtained was not complete; and the national income estimate for that year was not carried beyond the skeleton stage.

If one examines the material for 1943 from the point of view of productivity per unit of labour, the most striking impression received is of the variation in net product per worker in different branches of manufacturing industry. The net product per worker is used here to mean the value of the product at factory, less the cost of raw materials

used during the year, divided by the average annual employment. Certain industries (aerated waters, brewing, condensed milk, meal and feed, soap and margarine, essential oils, tobacco) show an annual net product per worker in the range £500-£1,000. Others (bricks and tiles, copra, cottage industries, furniture, tailoring, lumber milling, metal products and repairs) show a figure of less than £50 per annum. Broadly speaking, the industries in the first group are all, with the partial exception of tobacco, carried on in factories. The second group includes large numbers of domestic outworkers (e.g. tailoring and dressmaking workers) and of small workshops run by self-employed or own account workers (cottage industries, tailoring, furniture, metal repairs).

The average net product per worker in manufacturing industry in 1943 was about £95, if one adopts a definition of manufacturing industry which is in line with that used in the 1946 census of manufactures. If, however, one includes dressmaking and tailoring workers outside the factory, the average is only £75. The comparable figure for highway construction is £72, and for the construction of buildings £83. It is not easy to arrive at a comparable figure for distribution, partly because of the difficulty of applying the concept of net product in that field and partly because the 1943 national income figures were based on total distributors' margins and so include the value of transport used in distribution, but a figure of £190 can be estimated for retail distribution and £950 for wholesale. For passenger transport the net product per worker appears to have been about £290, and for telegraph and telephone services £330. For financial services and banking the average net product, so far as such a concept can be given meaning, was in the range £500-£1,000. For agriculture the annual net product was probably not greater than £60 per worker: but it must be remembered that an attempt to value the whole production of Jamaican agriculture raises two problems which have no exact practical or even theoretical solution—the valuation of the considerable part of the product which does not enter into the market and the assessment of the labour employed on small family holdings. For cane farming, the branch of agriculture in which these problems are least troublesome, we can be fairly confident that the true figure of net product per worker lies between £50 and £70.

In 1943, therefore, the majority of the Jamaican labour force was engaged in industries which yielded an annual net product per worker of considerably less than £100. Certain factory industries and certain types of services showed figures considerably higher than this, but they were all small in number. Groups with a conspicuously low productivity per unit of labour included agriculture in general (220,000 persons), domestic service (60,000), and outworkers and own account workers in some branches of manufacturing industry (at least 30,000); the moderately high figure for retail trade as a whole probably conceals a low level among the large number of small traders. These groups

account for almost three-quarters of the Jamaican labour force at that date.

The 1946 census of manufactures provides material for further study of manufacturing industry. The results of this census have been discussed elsewhere (6) and only some leading points are given here. The average annual net product per worker in the establishments covered by that census was £262, or almost three times the value already quoted for 1943. An important element in this disparity is the fact that the 1946 figures omit outworkers and the smallest establishments, and may be biased toward the larger establishments in the range supposedly covered. There was also a general price rise between 1943 and 1946. The official cost of living index rose by only ten per cent. but this probably underestimates the actual rise in general prices. The index of export prices rose from 183 to 260 between 1943 and 1946 (1938 = 100) and that of import prices rose from 213 to 279 (1938 = 100) (5). The former affects the net product per worker of the whole field of manufacturing industry directly, since the milling of sugar for export accounts for a large part of Jamaican manufacturing industry in the narrower sense used in 1946. In fact the sugar industry accounted for 30 per cent of the workers and of the total net product of the establishments covered by the census of manufactures in 1946. The import price index affects the net product per worker in domestic manufacturing industry indirectly through its effect on domestic prices.

The 1946 figures show the same considerable range of net product per worker from industry to industry as in 1943. One can distinguish three fairly homogeneous groups. One consists of those in which the process requires the handling of the raw material in liquid or at any rate in bulk form; these are distinguished by a generally high net product per worker and a high degree of capitalisation, and the highest net product and the highest degree of capitalisation per worker are found in the largest establishments. A second group consists of industries in which a local raw material is put through a few simple processes; the industries in this group are generally distinguished by the use of seasonal and unskilled labour, the net product per worker is low (even after allowing for seasonal effects) and so is the amount of capital per worker. The third group consists of industries not included in the other two, most of which may be classed loosely as assembly industries—e.g. cooperage, furniture, shirt-making, printing. In net product and degree of capitalisation per worker this group is intermediate between the other two; and net product, but not degree of capitalisation, is higher in the larger establishments.

While no exact figures for the other branches of the economy in 1946 are available, it is unlikely that agriculture showed as marked an increase as manufacturing industry, though cane farming was favourably affected by the increase in the export price of sugar. Distribution, on the other hand, may have shown an even greater increase, since

1946 was the first post-war year in which importation was freed from wartime restrictions, and margins on some lines, particularly durable household goods, were high.

A good deal of interest centres in the first group of industries described, since they are those in which the net product per worker in value terms, and also, as is shown in the next section, the physical product per worker, approach closest to European and North American levels. Unfortunately, in these industries the level of productivity attained is dictated largely by the technical features of the process, though it may be affected by the general labour situation through the choice of ancillary process, e.g. hand or machine packing. The level of productivity attained is less dependent than in other types of industry on the intrinsic qualities of labour. The limitations of productivity statistics in these industries are discussed below in connection with the use of measures of physical product per worker.

Broadly speaking, the differences in net product per worker from industry to industry within the Jamaican economy are parallel to those found in other economies. The industries which have a higher than average level of net product per worker in Jamaica are on the whole those which have a higher than average level elsewhere. An examination of the censuses of manufactures of the United States, Puerto Rico, Palestine and Australia shows however that the range between industries with high and with low value productivity per unit of labour is greater in Jamaica than in any of these countries, and that it is greater for Puerto Rico and Palestine than for the United States and Australia. It seems probable both on these grounds and *a priori* that the variations in productivity within a 'backward' economy are likely to be greater than within an 'advanced' one, and that the lower limit of productivity—represented, say, by agriculture—will be the most variable element from economy to economy, while the upper limit, represented by certain types of factory with a high capitalisation such as soap factories and breweries, will vary much less from place to place.

Bearing these facts in mind, one has to take account of two elements in the relatively low level of value productivity per head in the Jamaican economy. One is a general difference in level of output; the other represents the combined effects of the differences within the economy and of the greater numbers of workers found in Jamaica in the industries with the lowest levels of output per head, in comparison with almost any other economy which is likely to be used as a standard. The point may be illustrated as follows. Below are shown the approximate annual gross product per worker of the main branches of the Jamaican economy, and the average gross product per person in the occupied population obtained by applying to them, first, the weights given by the actual occupational distribution in Jamaica in 1943, and second, the weights given by the occupational distribution which obtained in the United Kingdom in 1948.

TABLE 1. AVERAGE PRODUCT PER WORKER IN JAMAICA, ACTUAL AND REWEIGHTED BY BRITISH OCCUPATIONAL DISTRIBUTION

Occupational Group	Average Gross Product per Worker, Ja., 1943 £	Weights Given by Jamaican Occupational Distribution	Weights Given by British Occupational Distribution 1948	Average Product per Worker Jamaican Weights	Average Product per Worker British Weights
Primary	56	48	10		
Manufacturing and Utilities	181	13	39		
Construction	43	7	7		
Distributive Trades & Transport	182	10	20		
Professional and Public Service	260	4	25		
Domestic Service	26	17	— <sup>a</sup>		
				£88	£147

<sup>a</sup> No information is available on the number of full-time resident servants of the Jamaican type in Great Britain, but since it is certainly small the group has been given zero weight here.

It can be seen that if the broad occupational groups in Jamaica had the same relative importance as in Great Britain, while the output per worker within each group remained as at present, the overall output per worker would be increased in value terms by about two thirds. A finer division of the grouping would probably intensify this effect.

In a sense therefore the low overall output per worker in the Jamaican economy may be said to be attributable to the relatively smaller share in the economy of high-productivity industries such as manufacturing and transportation and the relatively larger share of primary industry and domestic service. This, however, is a statement about the statistical nature of the overall level of output rather than about its causation; and it must not be taken to follow directly from this that any increase in the importance of manufacturing industry would *ipso facto* raise the overall level of output, or *a fortiori* the overall level of welfare. The distribution of the labour force between industries with high and low labour productivity, particularly in so far as this difference correspond to high and low capital/labour ratios, is a product of the underlying economic situation and any alteration of this distribution is important less in itself than as a manifestation of a change in this situation. To take an extreme example, it would be possible by subsidisation to call into being a manufacturing industry which would yield no net product except under such a subsidy; such an industry would constitute a nominal increase in the high-productivity sector of the

economy, if we define this sector in a way which necessarily includes manufacturing industries, but would not increase the overall level of output and welfare—indeed unless we envisage a very unlikely series of multiplier effects this level would probably be lowered.

When we approach the problems of low real income per head of population from the point of view of output per head of the occupied population, it is important to bear in mind the ratio, which differs from country to country, of the occupied to the total population. This ratio stands currently at about 40 per cent in Jamaica, against about 45 per cent in Great Britain (excluding armed forces). The question lies rather outside the sphere of this paper and is not explored in detail; but in general it is important here also to separate statements which refer in some degree to casual factors (e.g. the proportion of the population which is of working age, so far as it is a product of purely demographic factors) from statements which reflect aspects of the total economic situation which, like low or high labour productivity, are effects of the fundamental situation (e.g. the proportion of the population of working age that is actually gainfully occupied). If we are seeking to give the concept of real income per head more than a merely formal reality, we must also bear in mind that in countries with a population structure like that of Jamaica the 'dependent' part of the population is in the lower age groups, with a lower consumption level than that of adults, whereas in Great Britain and other countries with an 'aging' population the 'dependent' population is not much less in its consumption requirements than the working population.

This discussion of variations in net product per worker is intended to throw light on productivity in its more general sense rather than on the share in productivity variations which is to be attributed to variations in the quality of labour. In the terminology of this paper, it refers to productivity per unit of labour rather than to labour productivity. The variations in net product per worker from establishment to establishment or from branch to branch of an economy are determined to only a limited extent by the quality of labour. This can be seen more clearly if we consider the net product not as a unitary concept but as the sum of a number of quantities, the chief of which are wages, salaries, depreciation, interest on capital and profits. In a comparison of establishments in the same industry and in the same market field, the ratio of each of these quantities to the number of workers employed may be expected to vary positively with the quality of the labour available, with the possible exception of salaries, where better labour may require less supervision. But each item will also be subject to other influences. Wage per worker will be affected, for example, by union strength and by the type of community from which the labour force is drawn; capital charges, by the type of equipment used; and profits, by particular conjunctions of market factors. In a comparison of different industries, these possible influences are exaggerated by differences in fundamental processes, which may completely overshadow differences in the effi-

ciency of the labour employed. Thus the difference in efficiency between the British and Jamaican worker on similar operations was estimated by an International Bank Mission (9) as of the order of two to one; the possible differences between the value of capital employed per worker in industries of very different types is of the order of ten to one or higher. There is no doubt some tendency for the quality of labour employed to tend valuable equipment to be higher than that in industries with low capitalisation; but the qualifications of the average worker in some relatively low productivity industries such as furniture making are higher than those of the average worker in some highly capitalised, high-productivity industries where the labour employed is mainly of the operative grade. Variations in the net product per worker from branch to branch of an economy must not, therefore, be used to measure the relative efficiency of labour in the different branches.

While the value of the net product per worker forms a convenient instrument for exploring the differences in labour productivity within a single economy, it is rarely suitable for comparisons of productivity between economies with different currencies, price structures and market conditions. The physical product per worker per unit of time not only offers a way round the difficulties raised by differences in prices and currencies, but seems to constitute a peculiarly direct and simple means of comparison of the standard of labour productivity in different areas. It is, however, less simple than it appears. The data from which the physical product per worker is calculated are usually compiled on the basis of the establishment as a unit of measurement. The average physical product per worker in an establishment is determined by a complex of factors and the quality of the worker is only one of these. The manner in which the worker's capabilities are used depends particularly on the quality of management and on the relative prices of labour on the one hand and equipment and mechanical energy on the other. If it were possible to find two establishments for comparison which differed only in the quality of labour employed, the measurement of the relative physical product per worker would be also a measurement of the relative efficiency of labour. But such a comparison could hardly arise either practically or theoretically. In some fields of study it is sufficient to accept the value of the average physical product per worker without attempting to resolve it into its components. If, however, this statistic is to be used to study the relative efficiency of labour in different countries, its usefulness can be considerable provided that some supplementary information is available to show, however roughly, the share in differences in output which can be ascribed to factors other than labour.

It is difficult to find a single measure of the physical product of an establishment which can serve as a basis for a comparison with a similar establishment in another country unless the product of the establishment is homogeneous and can be measured in standard units. This fact constitutes another limitation on the usefulness of the physical

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product per worker as a measure of labour efficiency, because the industries which conform to this requirement are not typical of most economies, and are less typical of 'undeveloped' economies than of others. Of the six Jamaican industries studied here, four (sugar milling and the manufacture of ice, soap and margarine and aerated waters) belong to the category which has been called 'bulk process industries' and which has been shown above to be not typical of the Jamaican economy. Rottenberg (15) makes the same reservation in his study of the sugar refining, fertiliser, cement and electric power industries in Puerto Rico.

TABLE 2. OUTPUT PER MANYEAR IN CANE SUGAR MILLING

	Jamaica, 1946: all factories	Jamaica 1946: Census	Australia 1943-4	Hawaii, 1939 <sup>c</sup>	United States, 1939 <sup>c</sup>	Puerto Rico, 1939 <sup>c</sup>
Sugar produced ('000 tons)	165	115	524	980	434	998
Average employment	6500 <sup>a</sup>	2805	3800	4400	4200	7800
No. of establishments	26	12	36	35	78	40
Total value of fixed capital (£'000)	—	2390	9140	—	—	—
Output per worker (tons)	27	41	138	227	103	129
Output per establish- ment ('000 tons)	6.3	9.5	14.6	28.0	5.6	24.9
Output per £'000 of fixed capital (tons)	—	48	57	—	—	—
Fixed capital per worker (£)	—	850	2400	—	—	—
Wage costs as % of value of product	—	10	9 <sup>b</sup>	6	8	8

<sup>a</sup> Estimated.

<sup>b</sup> Wages and salaries 13%, share going to wages estimated.

<sup>c</sup> See (1).

The Jamaican sugar industry in 1946 had an output per manyear lower than that in any other of the countries cited in Table 2, and this is still true if the comparison is based not on the whole Jamaican industry but on the rather favourable sample of estates that made returns under the census of 1946. The years from 1946 to the present have seen considerable expansion and centralisation of production in the Jamaican sugar industry but it is doubtful whether any Jamaican factory can even now show an output per manyear as great as one third that of the average Hawaiian sugar factory in 1939.

The disparity between the Jamaican and Hawaiian levels of output appears to be equally great if both the field and the factory operations of the sugar estates are considered. In 1947, seventeen Hawaiian estates showed numbers of mandays per ton of sugar produced ranging from 5 to 19, with an average of 9. For all Jamaican sugar estates in 1943 the numbers of mandays per ton of sugar produced ranged from 17 to 66, with an average of 35-40. In the Queensland sugar industry in 1947 the average number of mandays per ton of sugar was 12-15. It may also be of interest to note that in the operation of harvesting the sugar cane the current rate in Jamaica on estates where this operation is not combined with that of loading the cane into carts is about 10 tons of

cane per worker per week, whereas the corresponding figure for Puerto Rico in 1949 was 17 tons per week and for Australia in 1948-9, 30 tons per week. The Jamaican cane cutter, however, often does not work a full week; allowing for this, the Jamaican labourer achieves in this operation approximately half the output of the Australian.

The average output per establishment in Jamaica is less than in Australia, Hawaii or Puerto Rico. Within the Jamaican industry there is considerable association between the throughput of the establishment and the output per worker. The following examination is based on the twelve Jamaican factories which made detailed returns under the 1946 census of manufactures. The main quantities employed in this analysis are the tonnage of cane purchased, the average number of persons employed over the year, the total wage and salary bills, the value of the fixed capital employed, and the charges recorded for materials, fuel, maintenance and depreciation. All of these were stated explicitly in the schedules, but there may be some ambiguity in the interpretation of some of the items. The tonnage of cane purchased has been treated as equivalent to the tonnage processed, without any attempt to allow for wastage in transit. The value of fixed capital is the written down book value, not the purchase or replacement value. The figure of average employment is obtained from the monthly averages, and is probably the most accurate possible in the circumstances. It is not possible to evaluate statistically the margin of error involved in these figures.

The indices of efficiency most commonly used are based on output rather than input. The input of canes is used here as a basis to avoid the problems raised by the manufacture of rum as a joint product with sugar. In the form in which the data are presented here, by broad size groups based on input of cane (see Table 3), there is probably a very close association between the variation in input of cane and in output of sugar, since the extraction ratio is almost the same for all four groups. In 1943 the number of tons of cane used in making one ton of sugar was for all factories 10.15; for the factories dealt with here it was 9.41, being 10.68 for Group I, 9.41 for Group II, 9.33 for Group III and 9.38 for Group IV. While this suggests that the sample is biased towards the factories with a favourable extraction ratio, it shows that the probable error involved in using the input of cane as a measure of efficiency within the sample is not large, since for three of the four groups of factories considered the ratio varies by less than 1 per cent.

TABLE 3. INPUT PER WORKER AND ANNUAL EARNINGS

Group	Input of cane (tons)	Tonnage of cane processed per employee	Tonnage of cane processed per £ of wage	Average earnings per wage earner
			bill	(£)
I	0- 25,000	152.9	1.735	79.9 <sup>a</sup>
II	25- 50,000	172.6	1.722	100.3
III	50-100,000	345.4	3.480	98.4 <sup>a</sup>
IV	Over 100,000	561.9	4.570	122.9

<sup>a</sup> Data for one factory not available.

The first index of efficiency obtainable from the data is the tonnage of cane processed per employee, shown in Table 3 above. There is a clear gradation in this quantity from 152.9 tons per worker in the factories with the smallest input to 561.9 tons per worker in the largest group. This is the result which would be expected, since in most continuous process industries the general efficiency increases with higher levels of input; moreover large input is commonly associated with a high investment in capital equipment, which in turn leads to high labour productivity. A comparison of input per £ of the wage bill shows that while there is an association between size of input and tonnage of cane processed per £ of wages for Groups II, III and IV, it is less marked than for tonnage per worker; while the figure for Group I is slightly higher than that for Group II. The difference between the two sets of results is accounted for by the association of large input with higher wages, as shown in column 5 of Table 3. In the largest group earnings are some 50 per cent higher than in the smallest; this difference may represent partly higher wage rates in the larger factories, but probably also longer hours of work, the consequence of more regular operation. (The larger group has a grinding season some 20 per cent longer than the smallest, but this difference should have been eliminated by the method of averaging employment over the year. It may also be noted that more shifts are worked in the largest group of factories.) On the whole, these results seem to indicate greater efficiency in the larger factories in the utilisation of labour, the differences involved being too great to be discounted by the probable errors in the method of calculation. But it should be remembered that the number of factories covered is small, though it represents almost half the sugar factories in Jamaica in 1946, and the variation within the groups is large. If the data had been presented in their crude form it would have been plain that the association between size of input and labour efficiency is much less clear-cut than the above grouping suggests.

It would be misleading to present the input per unit of labour as the only index of efficiency in sugar manufacturing in Jamaica. Even where labour is a scarce factor of production and a relatively important element in costs, the efficiency of utilisation of capital and managerial ability needs to be considered. In Jamaica labour, particularly unskilled, is abundant, while the other factors are scarce. Moreover, in sugar manufacture labour is a smaller element than capital charges and maintenance in total costs, and labour costs as a whole are only three times as great as the salary bill. Table 4 shows indices of efficiency based on the input relatively to the fixed capital and to the salary bill.

It will be seen that the input of cane, relative to each £100 worth of fixed capital, rises with increasing size from 23.4 tons for Group I to 66.6 tons for Group III, and that though the figure for Group IV (44.2 tons) is lower than for the preceding group, it is higher than for either Group I or Group II. These results suggest that among the factories included here the efficiency of utilisation of capital is highest in those of 50 to

TABLE 4. INPUT PER UNIT OF CAPITAL AND OF SALARIES

Group	Input of cane (tons)	Tonnage of cane processed per £100 of fixed capital	Tonnage of cane processed per £ of salary bill
I	0- 25,000	23.4	4.87
II	25- 50,000	34.9	3.76
III	50-100,000	66.6	6.86
IV	Over 100,000	44.2	19.43

100,000 tons input capacity, rising to that size and showing a considerable fall thereafter. The crude data reinforce this conclusion, the decline in input per capital unit being continuous throughout Group IV. These figures, however, refer only to fixed capital, and it may be that the utilisation of working capital is better in the largest factories, thus compensating for the less efficient use of fixed capital. A return was made under the census of the value of inventories and outstanding accounts at the end of the calendar year, but these must form a very imperfect measure of the working capital employed, as they take into account neither the period for which the capital is employed, nor the possible variations between estates at a given date which would be attributable to the crop season beginning earlier or later than the average. These figures suggest that working capital utilisation varies in the same way as that of fixed capital, the greatest efficiency being found in the factories in Group III.

The last column of Table 4 shows the tonnage of cane processed for each £ of the salary bill, for each group. It will be seen that there is a very sharp rise in this figure with increasing size from Group II to Group IV, and that the figure for Group I is slightly higher than for Group II. The efficiency of utilisation of salaried labour (which here includes managers, professional and technical employees, clerks and sale agents) would therefore seem to be markedly higher in the larger factories. It is often said that the problems of management, and hence the proportion of costs to be attributed to salaries, increase rather than decrease with increasing size and complexity of organization, but in the group of sugar factories studied here the opposite is true. The explanation may be that in the larger factories the process of production is more fully automatic, and so requires less labour for supervision. It is probable also that in the smaller factories the separation between managerial and other duties is not clear, and that a professional worker will also be doing a foreman's work to a greater extent than in the largest establishments.

In the group of factories studied it appears that the utilisation of both wage and salaried labour is more efficient, the greater the input of cane (and by inference, the greater the size of the factory); while the utilisation of fixed capital is most efficient in Group III, the second largest group. In order that the influence of these items on total costs may be roughly assessed, the proportions which labour, material, fuel and maintenance costs, and depreciation charges, bear to the total of

all these payments, is shown for each group in Table 5. The variations in the relative importance of the items from group to group follow the pattern already remarked; wages and salaries show a tendency to decrease in importance with increase in size of input, while capital charges are at their lowest point in Group III. By far the largest item, and one which increases in importance with increasing size, is the cost of materials and fuel. About ninety per cent of this item represents the cost of cane purchased from farmers or taken over from the field side of the estate. The cost of cane is therefore by far the largest single item in expenses. This introduces an element of arbitrariness into any cost analysis of the factories, since where the bulk of the cane used is grown on the estate it is impossible to know whether the price set down in the schedules represents the true market value of the cane used, or whether it has been written up, or down, as a matter of bookkeeping convenience. There is no positive ground for believing that the general relative importance of the different items or their variations from group to group has been misrepresented from this cause.

From the importance of cane costs in total costs it follows that any factor in efficiency which affects the yield of sugar per ton of cane is likely to have a disproportionate effect on total costs, while variations in other factors—for example, labour costs—will not greatly affect the total. A ten per cent reduction in material costs would be more than sufficient to outweigh a fifty per cent increase in wages; and variations in salary costs would have an almost negligible influence on the total costs of any of the groups. To establish whether the efficiency of utilisation of materials, in a mechanical sense, shows any systematic variation it would be necessary to have the results of chemical control tests, which is not possible. But it is possible to gain some information from the sucrose content of cane and extraction rates for 1943 (12). The number of tons of cane required for one ton of sugar varies little between the groups, as noted above. But this is the result of several factors, of which the mechanical efficiency of extraction is only one. Other important ones are the sucrose content and fibre quality of the canes available to the factory. It is possible to make some allowance for differences in sucrose quality of cane by comparing for each factory the percentage of sucrose by weight in the cane supplied with the percentage weight of sugar extracted from each ton of cane, using the figures for 1943 published in the report. The relation between the potential yield per ton, measured by sucrose content and the actual yield gives some measure of the mechanical efficiency of the plant, though without eliminating all differences in the natural quality of the cane used. The actual yield as a percentage of the potential on this basis is for Group I, 76 per cent; for Group II, 87 per cent; for Group III, 88 per cent; and for Group IV, 88 per cent. The differences between the last three groups are too small to be significant, but efficiency of extraction is lower in Group I by some ten per cent than in the higher

groups. The combined input of the factories in Group I is only four per cent of that of all the factories covered.

TABLE 5. WAGES, SALARIES, MATERIALS AND CAPITAL CHARGES AS PERCENTAGES OF TOTAL COSTS

	Percentage of total recorded costs:					Fixed Costs
	Wage Bill	Material & Fuel Costs	Prime Costs	Salary Bill	Maintenance, depreciation and rent	
Group:						
I	16.7	50.8	67.5	6.0	26.5	32.5
II	18.2	57.3	75.5	8.3	16.2	24.5
III	11.1	71.9	83.0	5.6	11.3	17.0
IV	9.6	73.1	82.7	2.3	15.0	17.3
Total	11.5	69.5	81.0	4.0	15.0	19.0

TABLE 6. COST PER TON OF CANE PROCESSED AND PER TON OF SUGAR PRODUCED

Group:	Percentage of average cost:	
	Per ton of cane processed	Per ton of sugar produced
I	139.7	158.6
II	129.5	129.5
III	104.4	103.5
IV	91.8	91.5

Since the average Jamaican factory has a smaller throughput than the average factory in such high-productivity sugar areas as Hawaii and Australia, and since the association of size with productivity per unit of labour is marked within the Jamaican industries, there is some ground for ascribing the low average output per worker in Jamaica to the smallness of the average Jamaican factory. But there are certain qualifications to this point of view. The difference in output per worker (and also per unit of fixed capital) between large and small Jamaican factories which has been shown to exist is not a simple matter of greater technical or managerial efficiency with increasing size. A part of the difference is to be ascribed to the fact that the largest factories are also on the whole the most recently built, and therefore embody more modern equipment. That the enterprises which have erected these newer factories should have chosen to operate on a large scale is again partly, but not wholly, the result of the inherent technical advantages of a large throughput. It must be noted also that the size of a factory is determined not only by the internal efficiency of operation but also by the available cane supply and the cost of bringing the cane to the factory. The development of large factories has been marked in areas which offer an unbroken expanse of level land suitable for cane—where, in other words, the cost of bringing a sufficient supply of cane to a

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central point is small. If we are comparing a factory with an output of 50,000 tons of sugar situated in the plains of Clarendon with a factory of 5,000 tons output in the hills of Trelawny, on all indices of efficiency of internal operation the former will have the advantage; but the larger factory would not be an economic unit if transferred to the situation of the smaller. The average size of factory in the sugar industry of a given country is therefore partly an expression of the natural suitability of the terrain for large scale cane cultivation.

Among the factories with small inputs in 1946 were some with considerable capital equipment, apparently designed to operate at much higher levels. This may be set down partly to the shifts in cane supply which have taken place over the last thirty years, because of extensions of cane cultivation which failed to maintain themselves after the booms of 1921 and 1928 and because of the effect of the introduction of truck and tractor haulage. In 1920 a cane producer situated near to one estate might nevertheless send his cane to another further away but near to the railway, since a long rail journey might be cheaper than a relatively short road haul by cart. The internal combustion engine enabled road transport to compete successfully with the railway in cane haulage. The reduction of the cane supply of a factory much below its designed input is likely to lower its efficiency on all indices, and in particular to produce a heavy capital investment per ton of cane. A similar effect would be produced to some extent by an attempt to rationalise the production of sugar in the most efficient factories, a policy which has often been advocated; but it does not seem that in fact such an attempt has been made, in spite of the strong recommendation of the Sugar Industry Commission of 1944-5 (12). A number of smaller factories have amalgamated since 1945, however, apparently by independent negotiation.

The distribution of the proceeds of the sale of sugar and rum did not take place on a *pro rata* basis in 1946 and it appears that the method of distribution did not secure the same results as would be obtained in a competitive situation. The data on costs secured from the 1946 census results indicate that some of the smaller factories could not operate at all in a competitive situation, since at the 1946 export prices of sugar and rum their prime costs, estimated by the same procedure as in Tables 4 and 5, exceed the possible revenue. Such a state of affairs can only persist if the operations of the smaller factories are subject to some form of subsidy by the rest of the industry. Hence the results obtained above are hardly to be compared with studies of the relation of size to efficiency done under such conditions that input and output are determined in a competitive market. The problem involved is much more nearly that of the allocation of output between plants of different efficiencies within the same firm.

Though the scale of operations must be given some weight as a reason for the low output per worker in the Jamaican sugar industry in comparison with other principal producers, the fact that the largest Jamaican factories, with an output equal to the average in Hawaii or

Australia, show a considerable inferiority in output per worker makes it clear that other factors are important. The explanation does not lie in differences in basic equipment. Even within the Jamaican industry such differences are small, and the more modern Jamaican factories certainly do not differ substantially from factories of similar size elsewhere. In most industries of the bulk process type the possibility of such variation is small. Differences probably arise in two main areas; first, the substitution of labour for capital in the ancillary processes of the factory, and second, a lower intensity of work obtained (or required) in these ancillary processes than elsewhere. The main ancillary processes in sugar manufacturing are the handling of the cane between the transport which brings it from the field and the first stage of grinding; the handling of the sugar from its leaving the hopper to the point where it passes out of the hands of the factory; and the handling of fuel and bagasse. Factories may differ widely in the problems they encounter at these points—e.g. a factory which ships sugar overland to a refinery has a different handling problem from a factory which ships by sea; a factory receiving canes from an internal rail system has a different problem from one receiving substantial amounts of cane by miscellaneous types of transport from outside suppliers. The same general problem, moreover, may be met in different ways involving different proportions of labour and capital; and it is not necessarily true that an innovation which reduces labour expenditure must involve an increase in capital equipment—a rearrangement of existing units made under the pressure of rising costs may increase the efficiency of both capital and labour. Since the number of workers who may be employed on handling where labour is relatively cheap can be large in relation to the number needed to operate the basic equipment, variations in ancillary processes may affect the apparent productivity of the factory drastically, from the point of view of output per worker. However, the workers employed on handling under a 'labour-profligate' system are likely to be unskilled and their wage rates low; so that output per unit of the wage bill, and the proportion borne by wage costs to total costs, should be less variable than output per worker. In fact, the proportion wage costs bear to total costs is relatively stable (Table 2).

Rottenberg (15) observes that in Puerto Rican industries of the same general type as sugar milling the field of choice between 'labour-saving' and 'labour-profligate' procedures is limited to handling and to control of the process, and that the relatively low island wage level leads to the choice of 'labour-profligate' methods. 'The consequence of management decisions of this kind, however, is to keep the productivity of labour low, because labour is combined with small quantities of capital, and to "freeze" wage rates at relatively low levels'. It would be an oversimplification to say that in Jamaica, and particularly in the sugar industry, the only important consideration governing the choice between labour-saving and labour-profligate methods is that of cost, even

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if we take into account the possible savings which may be obtained from the greater flexibility of direct labour methods in face of changes in output. The choice is also influenced by the desire of management to keep as far as possible a nuclear labour force available during the out of crop season, which provides an incentive for using a larger number of workers on out of crop maintenance than would be entailed by a mere calculation of alternative costs; while the fact that dismissal of labour may lead, directly or indirectly, to costly strikes is a strong motive for postponing as long as possible any change which substitutes capital for labour. It is true that such an attitude tends to keep the level of labour productivity low in a statistical sense; but it is not easy to determine whether in the circumstances of the Jamaican economy it has an effect on the level of output per head of population.

TABLE 7. OUTPUT PER MANYEAR IN ICE MANUFACTURE

	Jamaica 1946	U.K. 1935	1935	U.S. 1937	1939
Tonnage of ice produced per operative per year	1500	750	1550	1650	1925

The output per manyear in the manufactured ice industry in Jamaica is higher than in the British ice industry in 1935 and not far below that of the U.S. industry in 1939. This comparison, relatively favourable to Jamaica, must be qualified since the Jamaican industry has some special features. The manufactured ice industry in Jamaica is highly concentrated, the greatest part of the output being produced by two Kingston factories which are large by comparison with the average American factory. The Jamaican industry is not subject to a sharp seasonal fluctuation in demand as is the British and the apparent volume of product per operative is increased by the fact that some of the output of the factories is sold to small traders for distribution, whereas in the United Kingdom most of the output is distributed by the factories.

The data on Jamaican output are derived from the Census of Manufactures of 1946, and those of British and American output from Rostas (13). The time gap between these two sets of data is unfortunate, and it must be borne in mind that any technical progress made in this industry between 1935-9 and 1946 will tend to make a comparison based on these data unduly favourable to Jamaica. The same is true of other industries for which output data are given below based on the same sources.

Much short time was worked in the Jamaican factory. Annual hours in 1946 were 1,280 against a full working year of 2,000 hours in the high wage countries, so that the ratio measuring the Jamaican disadvantage needs to be reduced by a third if it is to measure relative productivity per manhour. The match industry is another example of an industry in which the main process is highly mechanised, but there

TABLE 8. OUTPUT PER MANYEAR IN MATCH MANUFACTURING

	Jamaica 1946	Australia 1948	U.K. 1935	U.S. 1939
Output (million matches)	979	23717	78800	419000
Average employment	250	1010	3380	5430
No. of establishments	1	5		28
Output per manyear (million matches)	3.9	23.5	23.3	77.2

is room for considerable variation in the equipment used for packing and handling. When the Jamaican factory was equipped a machine was installed to pack the completed matches into boxes, but this was removed at the instance of one of the trade unions and this stage of the process is now done by hand. This is an example of the way in which labour may safeguard its own immediate interests at the expense of those of the consumer, particularly when unemployment is widespread, and it is a type of manoeuvre which is particularly likely to occur in a completely protected monopoly since any extra cost involved will be passed on to the consumer with little loss of revenue and there is little incentive for management to resist labour or political pressures.

All the comparisons given in Table 8 relate to high-wage countries. Some data taken from the Indian Census of Manufactures of 1946, not on a completely uniform basis with the data used above, suggest that the output per manyear in the Indian match industry is about three times that in Jamaica.

TABLE 9. OUTPUT PER MANYEAR IN BREWING

	Jamaica 1946	U.K. 1935	U.S. 1939
Output (million gallons)	0.9	78.5	1364.9
Average employment	120 <sup>a</sup>	54936	36088
No. of establishments	1		
Output per manyear ('000 gallons)	7.5	14.3	37.8

<sup>a</sup> Estimated.

The figures on the single plant which represents the brewing industry in Jamaica are derived from non-confidential sources. The Jamaican plant produces only bottled beer, which probably increases the labour requirements per gallon compared with the United Kingdom industry where draught beer is important.

Several concerns in Jamaica manufacture biscuits, but data are available only for the one plant which produces biscuits (chiefly crackers) on a large scale. Output on a crude weight basis was in 1946 194 cwts. per operative, against 134 cwts. in the United Kingdom in 1935 and 487 cwts. in the United States in 1939. An arbitrary element is introduced into the comparison by the fact that the British industry produces a larger proportion of high quality biscuits more elaborately packed, with presumably a higher labour requirement per unit of weight.

TABLE 10. OUTPUT PER MANYEAR IN SOAP AND MARGARINE INDUSTRY

	Jamaica 1946	U.K. 1935	U.S. 1939
Output of soap and edible products (million lb.)	16	1512	3872
Average employment	387	14653	13109
Output per manyear, weighted by relative Jamaican output of soap and edible products ('000 lb.)	42	114	307

The soap and margarine industry is represented in Jamaica by two factories manufacturing a similar range of products, chiefly soap, margarine, cooking fats and edible oil. It is impossible to separate productivity in the soap making branch from that in the edible products. In most other countries these two branches are treated by the census as two distinct industries. To secure a single figure which can be compared with the combined output per manyear of the two branches of the Jamaican industry, production per manyear has been calculated for each branch separately in other countries and the results averaged using as weights the proportions by weight in which the two types of product entered into the total Jamaican output.

Data are also available on the Australian soap and margarine industries. The average employment per factory is 40 in the soap and 22 in the margarine industry, or considerably less than in Jamaica, and average output per plant is also less. The Australian industry appears to be much less concentrated than the Jamaican, corresponding to the greater dispersion of its sources of raw material. The output per manyear (weighted by the proportionate weights of the two types of product in the Jamaican output) is 57,000 lb. in 1948. The value of fixed capital per wage earner for 1943-4 was of the same order as that in the Jamaican industry. The wage costs for that year in Australia formed 30 per cent of the value added in manufacture, against only 13 per cent in Jamaica. This appears to be a case where the difference in wage rates between Jamaica and a high wage country is not offset by a difference in productivity per manyear.

The Jamaican industry is based almost wholly on vegetable fats whereas the British, American and Australian are based partly or mainly on animal fats; so that the processes involved are not identical. The stage at which the raw materials are taken into the process — e.g. as copra or as coconut oil—may affect the labour requirements as between different countries.

The aerated water industry in Jamaica has an output per manyear about two thirds as high as that in the Australian and New Zealand industries, with a lower value of fixed capital per unit of product but a larger average size of establishment. In spite of its lower output per manyear, the Jamaican industry spends proportionately much less on labour.

This industry provides an example of the difficulty of defining an

TABLE 11. OUTPUT PER MANYEAR IN AERATED WATER MANUFACTURING

	Jamaica 1946	New Zealand 1943 <sup>a</sup>	Australia 1948
Output ('000 gallons)	1241	2707	44826
Average employment	223	320	4833
No. of establishments	7	114	568
Output per worker ('000 gals.)	5.6	8.5	9.3
Output per establishment ('000 gals.)	180	24	80
Output per £'000 value of fixed capital ('000 gallons)	29.5	9.6	
Fixed capital value per worker (£)	188	884	
Wage costs as % of value of product	6.5	19.7	

<sup>a</sup> See (2).

industry in such a way as to permit useful comparisons between two different economies. The establishments covered by the 1946 census of manufactures in Jamaica were representative of the aerated waters industry in Jamaica so far as it is carried on in factories. But the drink which corresponds in the Jamaican pattern of consumption to the American 'coke' is the 'snowball', a drink made of ice and fruit syrup sold from handcarts by street vendors, who operate with the minimum of capital and perform both a manufacturing and a commercial function. If the Jamaican industry is to be compared with that in other countries the existence of these vendors, with their very low productivity, must be kept in mind.

TABLE 12. OUTPUT PER MANHOUR IN TOBACCO MANUFACTURING

	Jamaica 1946	U.K. 1935	U.S. 1939	Australia 1948	New Zealand 1948
Average employment	2414	35700	87500	5400	978
Output ('00,000 lbs.):					
All branches	14	2012	8560	300	70
Cigarettes	9.6	1478	4154	101	30
Cigars	4.5	11	966	2	—
Tobacco & snuff	—	512	3440	197	40
Estimated production per manhour (lbs.):					
All branches	0.23	2.25	4.79	2.53	3.26
Cigarettes	1.94	3.24	8.29		
Cigars	0.08	0.32	1.00		
Tobacco & snuff	—	1.30	10.67		

The manufacture of tobacco products consists of three branches; (a) cigarettes (b) cigars and cheroots (c) pipe tobacco, cigarette tobacco and snuff. These branches have different manhour requirements per unit of weight of product. The constitution of the Jamaican industry is such that the productivity in the separate branches cannot be exactly calculated. The estimates given in Table 12 are subject to a margin of error of plus or minus 30 per cent.

In 1946 one third of the total output (by weight) of the Jamaican tobacco industry consisted of cigars and cheroots, a higher proportion

than in most countries for which comparable figures are available. The manhour requirements for cigars are higher than for cigarettes and tobacco, so that the importance of cigars in the Jamaican tobacco industry is a partial explanation of the low level of output per head in the industry as a whole.

This examination of various industries suggests some general conclusions. All the industries and countries examined show the level of productivity per manyear or manhour to be lower in Jamaica than in the corresponding industry elsewhere, except for two cases which special circumstances render of no great weight; and in most cases this disparity is so large as to make any probable defect in the data used unimportant. The countries with which comparison has been made are, however, usually considered to be 'high-productivity' countries. The industries studied which show the largest differential in productivity are match and cigar manufacturing. Of these the first is known to employ hand processes to a greater extent than is usual elsewhere, partly because of direct union pressure and partly because the price of labour makes it possible to yield to such pressure, while the second is almost entirely a hand industry in Jamaica and almost entirely a machine industry in the United Kingdom and United States. Of the other industries, all are of the 'bulk process' type with their main features imposed by the nature of the process. The smaller aerated waters plants may not conform as closely to this picture as the rest. In certain cases the relative levels of capital per worker seem to show an association with relative levels of output per worker, but the nature of the industries studied is such that such covariations of capitalisation and productivity probably denote variations in the handling and packing of the product rather than in the basic process. This has some importance in view of the fact that changes can usually be made more easily and cheaply in the ancillary processes of a plant of the 'bulk process' type than in the basic process. Since the existing differentials between Jamaican and foreign industries of this type are relatively small it seems possible that productivity in these industries could be brought up to British or even American levels without great difficulty if the relative prices of labour and capital in Jamaica were such as to make this profitable.

Study of other industries for which it is not feasible to calculate a figure of physical product per worker suggests two further points. The first is that differences in the value of fixed capital employed per worker between Jamaica and the other countries are smaller in the 'bulk process' industries than in other types of industry, such as shirt and furniture manufacturing. Moreover, in many cases to raise productivity in such industries as the latter by a significant amount not only would considerable increases in fixed capital be required but also fundamental reorganisation of the whole process. The problem of raising productivity in these industries presents more difficulty than in the 'bulk process' industries.

A second point is that in spite of low levels of productivity wages do not form a higher proportion of total costs in Jamaica than in corresponding industries elsewhere. Indeed, the soap and margarine industries of Australia and New Zealand offer an example of a level of physical product per worker close to that of the Jamaican industry accompanied by a much greater relative wage bill.

TABLE 13. RELATIVE OUTPUT PER MANYEAR IN CORRESPONDING INDUSTRIES, JAMAICA AND ELSEWHERE

Country and Year of Comparison:	U.K. (1935)	U.S. (1939)	Australia (1948)
Output per manyear in Jamaica as percentage of output elsewhere:			
Match manufacturing	17	5	17
Cigar making <sup>a</sup>	25	8	
Soap and margarine	37	14	74
Brewing	52	20	
Cigarettes <sup>a</sup>	59	23	
Biscuits	145	40	
Cane sugar milling		40	30
Ice manufacturing	200	78	

<sup>a</sup> Output per manhour.

TABLE 14. HORSEPOWER PER WORKER, AND WAGES AS A PROPORTION OF TOTAL COST

	Horsepower per Worker:			Wages as % Total Cost:	
	Jamaica 1946	U.S. 1939 <sup>a</sup>	Jamaican HP/Worker as % U.S.	Jamaica 1946	U.K. 1935 <sup>b</sup>
Match manufacturing	0.5	4.5	11	25	n.a.
Cigar making	0.1	0.4	18	30	n.a.
Soap and margarine	2.7	8.8	31	5	7
Brewing	3.4	9.8	35	5	10
Cigarettes	0.4	2.2	18	9	4
Biscuits	0.7	2.6	27	11	19
Cane sugar milling	9.1	n.a.		9	
Ice manufacturing	21.0	64.9	32	10	n.a.

n.a. — not available. <sup>a</sup> See (13) <sup>b</sup> See (14).

The technique used here yields information about levels of productivity in a limited sector of the Jamaican economy, but is least helpful in those areas where the need for clarification is greatest. The problem of Jamaican productivity is most important and most obdurate in the industries which are loosely organised and where the capital equipment is at a low level of quality and quantity, but it is difficult to devise techniques of study for these industries which will isolate the different components of the problem or even permit precise measurement of the level of productivity achieved.

The extreme example of this type of industry is the small enterprise such as the shoe repairing shop or the smallholding, on which the entrepreneurship, capital and much of the labour are concentrated in one person. The discussion of productivity in such an industry must take account of a fundamental difference between the problems presented by factory industry and those presented by the one-man enterprise. In the case of factory industry it is useful to discuss techniques for raising productivity on the assumption that the entrepreneur's motives are such that he will adopt such techniques where they can be shown to be profitable. In the case of the type of small enterprise mentioned above, and in the Jamaican situation, the entrepreneur cannot be assumed to perceive the profitability of a new technique so clearly or to adopt it once its profitability is demonstrated. It is necessary to investigate problems both of technique and of motivation. This involves consideration of general social questions of the type which arise equally in the case of the Jamaican unskilled worker, and indeed the line between the wage worker and the small entrepreneur is in Jamaica difficult to draw since so many smallholdings are held by part-time wage workers. There seems little doubt that some of the weaknesses of the Jamaican worker and of the small Jamaican entrepreneur as producers have broad social causes such as the relatively rigid social stratification, which minimises the desire of the lower class Jamaican to accumulate money in order to transfer himself to a higher social class. In a later part of this study an attempt is made to trace associations between social distinctions and levels of productivity among certain groups of unskilled Jamaican agricultural workers. The main object of this is to explore the motivation of the Jamaican as a wage worker; but it has relevance also to the small entrepreneur who is numerically and economically important in the Jamaican economy. Entrepreneurship in Jamaica covers a wide range of forms from the highly specialised and economically relatively 'rational' type found in large scale factory industry to the more primitive type associated with small enterprises such as small scale cultivation; and at the latter extreme the line between entrepreneur and worker is hard to draw. Hence the conclusions of the second part of this paper have a double relevance to the problem of productivity, first as a partial analysis of the motives which govern the Jamaican wage worker, and second as an indication that the same motives may be important in the case of the small scale entrepreneur.

Fig. 1

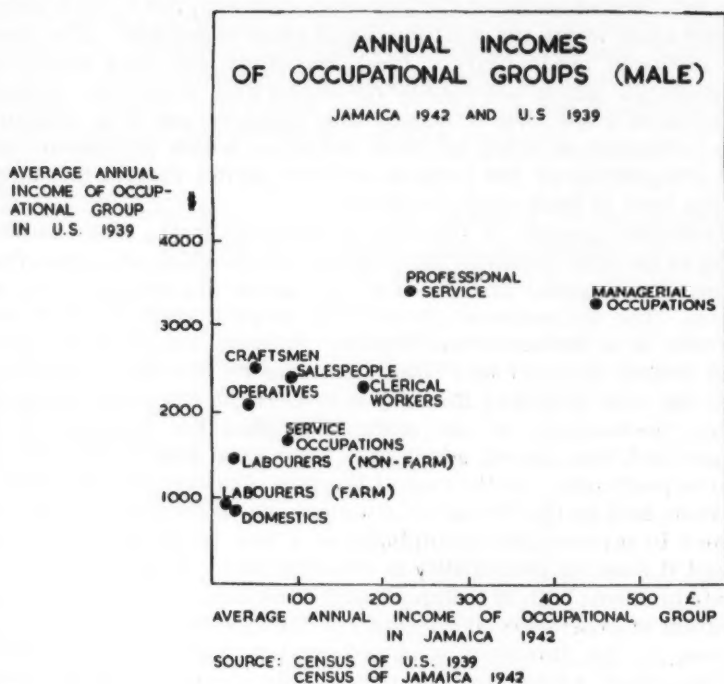


Fig. 2

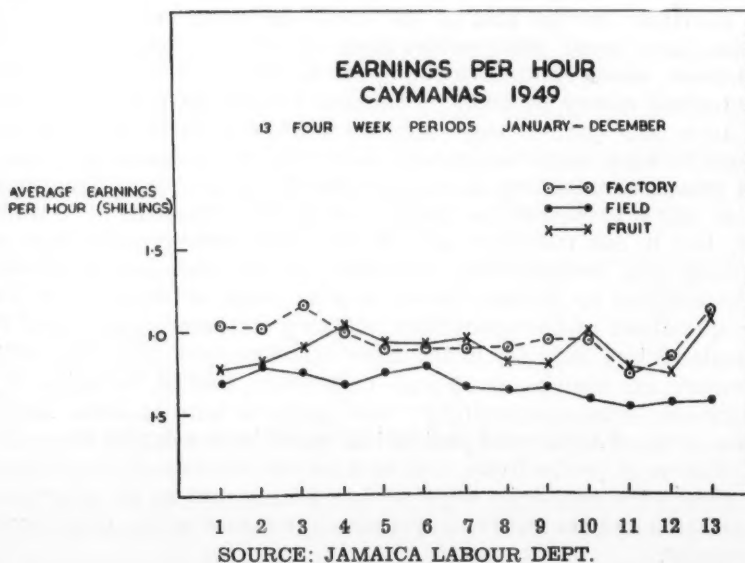


Fig. 3

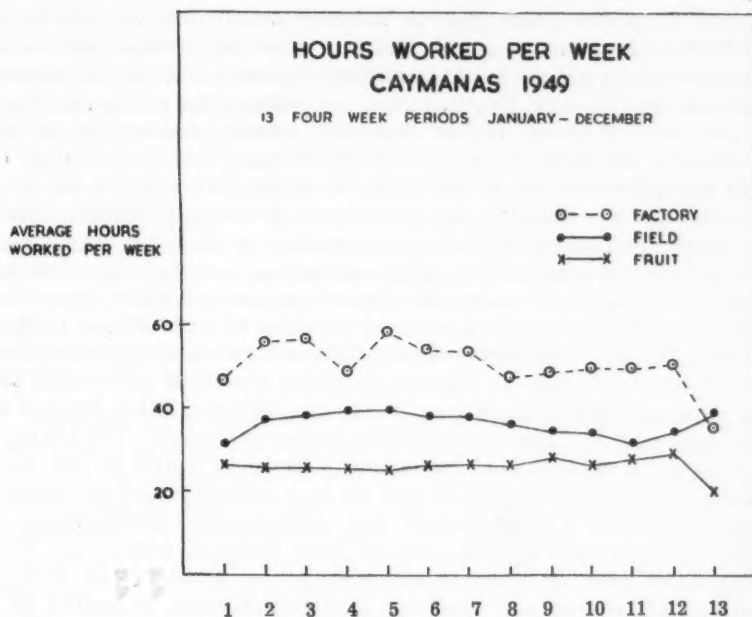
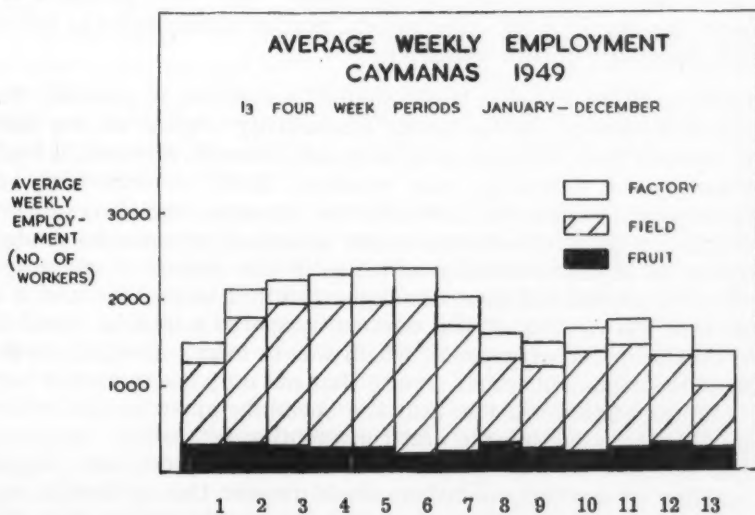


Fig. 4



SOURCE: JAMAICA LABOUR DEPT.

## 2. SOCIAL FACTORS IN LABOUR PRODUCTIVITY

There are three main types of statistic which may be held to be either measures of labour productivity or close approximations to it. The first is output per worker on an establishment basis. It has already been argued that in itself this measures the productivity of the establishment per unit of labour rather than the labour productivity in the strict sense of the workers in that establishment; but that it may be used as an approximation to the latter in comparisons where the general conditions of production can be shown to be roughly similar. Thus of the statistics quoted for various industries in Jamaica and Great Britain in the preceding section all those relating to industries in which conditions in the two countries appear broadly similar show the Jamaican output per man-year as lying between 40 and 100 per cent of the British figure. This would appear to be a reasonable approximation for the limits of the ratio in the two countries of output per worker per unit of time on similar operations, a measure which is often treated as representing relative labour productivity in the true sense. An example of how such a measure could be directly arrived at would be the comparison of the number of lines of type set by a Jamaican and an English linotype operator in a given unit of time, with as exact a stipulation as possible of the length of line, size of type, form of copy, and other working conditions; the ratio of the average Jamaican to the average British output on this operation has incidentally been estimated by a leading printing firm in the island at 2: 3. The International Bank Mission which visited the island in 1952 estimated that Jamaican industrial labour had a productivity on this basis which lay between 50 and 75 per cent of that of the British worker (9). This estimate was arrived at by comparing the opinions of a number of employers of labour who had experience in both countries.

Relative output on objectively similar operations is probably the simplest definition of relative labour productivity. When we are comparing workers from different economies and cultures, however, it leads to difficulties of definition and practice. Strict comparability of operations would require that not only the physical conditions of work but also such other circumstances as the system of payment be similar. The system of payment which is effective in one culture is not necessarily that which will call forth the highest output in another, and it is possible that the ranking of the workers compared might be found to depend on the system of payment which was in force. Further, an extension of the argument would require that not only the system of payment and the wage level, but also the spending opportunities which mediate between wage income and consumption be similar. Again, a principal incentive to high output is the desire for promotion. Strict comparability of working conditions would require that promotion opportunities be similar; and this, by extension, would require that this promotion have the same significance in terms of mobility within the general social structure. It would obviously be wrong for many pur-

poses to compare workers who had very unequal periods of training for their job. But the training of the worker is not limited to his time within the factory; the whole process of his education in the skills of communication and manipulation is relevant to his performance at a given time. Thus if we define relative labour productivity as relative output per unit of time in physically similar operations we are attributing to the worker qualities which are in a sense the products of his economic and cultural environment; while if we attempt to go beyond the stipulation of similarity in the physical operation to achieve a third and 'ideal' measure of labour productivity by setting up a fully standardised situation, we find ourselves led into absurdity. For a pair of workers in a fully standardised situation, even if such a situation could be actually contrived, would have lost the greater part of the identity in terms of which the comparison between them could be given meaning.

Spending opportunities, promotion opportunities, social mobility, training and general and specific education were all mentioned above as relevant to the problem of productivity. They were chosen in particular because they are all points at which the Jamaican worker is at a disadvantage in comparison with the English. Looking at the Jamaican worker's spending opportunities from the point of view of immediate consumption, the range of goods offered to him is relatively limited. The stock of 'working-class' stores is on the whole restricted and unattractive, while the social obstacles to a Jamaican working class man or woman shopping in a middle class store are much greater than those which stand between the English working class consumer and the English 'superior' store. Compared with England, or even more with the United States, the Jamaican economy shows relatively rigid consumption patterns, and the value to a worker of an extension of his income beyond its habitual level is consequently less than in more 'consumption-minded' economies. This is even more true of the rural than of the urban worker. Such a situation affects the worker's response to wage incentive systems.

From another point of view spending may be seen as a means to social promotion through the acquisition of the outward marks of a higher class. Income earned to be saved in order to acquire property or educate one's children may also be seen in this light. Here too the Jamaican worker is at a disadvantage. Economically, the gap between the working class and middle class is proportionately larger than in England and the United States (see Fig. 1) and the task of the working class man who wishes to acquire the economic standards of the middle class is so prohibitively difficult that only the very few attempt it. Socially, the fact that status is linked with colour restricts mobility, since a dark skinned man who has acquired the income and occupational attributes of the middle class will frequently fail to be accepted as belonging to that class, or if accepted will fail to identify himself with it. To make the effort required to move to a higher class involves in any

case considerable social strains through the dropping of old associates and ways of life; and where the reward is so uncertain it is not surprising that few attempt it.

Rigidity of social stratification is also connected with the fact that industrial promotion in the narrower sense is limited, there being rarely a continuous ladder of promotion within a factory. Generally speaking the worker cannot look forward to promotion beyond the foreman level. It is true of all economies that a large proportion of the upper managerial staff have not risen 'from the ranks', but promotional opportunities in Jamaica appear to be less than in the Western industrial countries.

Training in Jamaican factories is seldom intensive or highly organised. A study of training methods in a number of Kingston factories by E. Campbell will shortly be published in this journal.

In formal education the Jamaican worker is inferior to the British or American. This constitutes an obvious barrier to efficiency in many jobs, particularly when it manifests itself in illiteracy or incomplete literacy. Less obvious, but equally important for many jobs is the lack of facility in reckoning beyond simple addition. Another intangible but important factor is the failure of the Jamaican environment to provide the informal knowledge of simple technical processes which the English or American child acquires unconsciously. Even so apparently obvious a concept as rectilinearity, which is fundamental to most constructional processes, is not instinctively obvious but must be learned; it is easily acquired in an urban industrial environment, but less so in a primitive rural one. There are many primitive cultures in which rectilinear forms are rare. The English child is accustomed by daily experience to standards of construction and finish in all kinds of domestic objects which the Jamaican child may never encounter until, as an adult, he is asked to reproduce them for the consumption of others. The disadvantage of the Jamaican industrial worker in these respects is less than, for example, that of the rural African who is inducted into urban industrial life when an adult, and what disadvantage there is, is probably diminishing, but the point must be considered in evaluating the productivity of the contemporary Jamaican.

Enough has been said to show that the productivity of the individual is affected by a wide range of social factors. It is rare to find an occasion when the removal of an individual from one social framework and his establishment in another permits a quasi-experimental test of the importance of some of these factors. An approach to such a situation is found in the migration of Jamaican labour to the United States; such migration has fluctuated in importance and is now small, but during the war of 1939-45 its volume was considerable. It is hoped that it will be possible to make a study for later publication of the productivity of Jamaicans in the United States in relation to the nature and duration of their emigration, the type of work on which they are engaged and the effectiveness of their selection, training and acculturation. Emigration may be regarded from one point of view as a

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stepping outside the social system in which the worker has been born in order either to enter another or to re-enter the old one at a different level later. Comparison of the productivity of the migrant and non-migrant worker may therefore permit an approximate evaluation of the stimuli to and limitations on productivity provided by Jamaican society in comparison with that of the United States. It must be borne in mind that the migrant worker is not typical either of his society of birth or of the society of his adoption. Moreover, emigration may constitute a stimulus in itself.

While it is difficult to assess directly the effect of social influences on productivity, an indirect approach may be made to the problem by considering differences in productivity attributable to differences in the worker's position within the framework of a single society. It does not seem possible to establish as a matter of strict logic that the finding of considerable systematic differences in labour productivity between individuals in different social situations within one society implies that differences in the structure of two societies will cause differences in labour productivity between the two economies. But if the labour productivity of a worker can be shown to be associated with his situation within his own society, the case for giving social factors in general a considerable share in the determination of levels of labour productivity is at least strengthened; while the failure to find such differences will dispose one to question the importance of differences in social structure as explanations of differences in labour productivity from one economy to another.

Such an approach has another function in an economy where an attempt is being made to raise the level of productivity either of society in general or of important sectors of it. Economic changes often—indeed, in a strict sense always—imply social changes. Situations are likely to arise where the possible rate of economic change is limited by the possible rate of social change. For example, in a society where the possession of cattle possesses a peculiar social value a trend toward the substitution of fewer good beasts for many poor ones may be limited by persistence of a system of values which is based on numbers of cattle rather than on their market value. The exploration of social factors which are currently associated with high levels of labour productivity may throw light on the possible social limitations to a future increase in productivity.

A suitable situation for the testing of this approach to the problem requires two main features; that the workers studied shall show considerable social differentiation, and that they shall be free to manifest any tendencies to deviate from average levels of productivity in some easily measurable form. These conditions operating jointly restrict the possible field of study, since the workers in a single establishment commonly show considerable social uniformity while the comparison of the productivity of workers in more than one establishment complicates the problems of measurement and analysis. The conditions

are jointly fulfilled, however, among the field workers of a sugar estate, who may manifest wide differences in family and community type and whose productivity may be taken as highly correlated with their earnings, which they are able to vary widely over quite short periods of time. In order to explore the association between differences in productivity and in social situation, and in particular to study the importance of certain factors, field studies were carried out on two Jamaican sugar estates and these studies are reported in detail below.

Frome estate is situated in the most westerly parish of the island. The central factory from which it takes its name lies on the road which runs from Savanna-la-Mar via Grange Hill to Green Island in Hanover, and is about five miles north of Savanna-la-Mar; the cane fields of the estate lie in a rough circle around the factory with a radius of about four miles, and extend from the semicircle of hills on the north to the Whithorn-Savanna-la-Mar-Little London road on the south. While they are not continuous over this area, being interspersed with stretches of pasture and ruinate, and including three sizeable villages, yet an observer looking down from the hill near the central factory receives a vivid impression of the dominance exerted by the sugar industry. Savanna-la-Mar was formerly a principal port of the island; it is now an unprosperous town of about 6,000 inhabitants. Very few of the workers on the field side of the estate come from Savanna-la-Mar itself; considerable numbers of them live in three villages which are in a sense part of the caneland area—Petersfield, Grange Hill and Little London. A point in which Frome contrasts sharply with Caymanas the other estate studied is its isolation from Kingston and the main stream of political and social development in the island. The direct road from Savanna-la-Mar to Kingston, a distance of 140 miles, is in poor condition for half its length and constitutes a much greater obstacle to convenient travel than the equally long journey from Kingston to Montego Bay.

Frome is owned by the West Indies Sugar Company, a subsidiary of the Tate and Lyle refining interests, which also owns Monymusk estate in Clarendon and Caroni estate in Trinidad. Frome Central was built in 1938, superseding a number of smaller factories. It has a present capacity of about 50,000 tons of sugar, being the second largest in the island after Monymusk, and an extension to raise the capacity by another 10,000 tons is contemplated. It is technically very efficient and its cane achieves a high sugar content: its figure of tons cane per ton sugar has been below the island average for the last five crops (in 1952 the figures were 8.77 tons for Frome and 9.29 tons for the whole industry). The West Indies Sugar Company produces one third of the Jamaican sugar output and is the most important single influence on the management side of the industry.

Frome constitutes one division of the company, headed by a general manager. Under him are the business manager, factory manager and cultivation manager. It may be of interest to note that the general manager comes of an old Westmoreland white family, the business

manager is English, the factory manager Filipino and the cultivation manager a coloured Jamaican. The factory manager controls the running of the factory, distillery and maintenance section, and has under him a chemist and a chemical control section. The cultivation manager has in his division an agricultural research officer at headquarters, while the estate is divided for purposes of cultivation and reaping into sections, each with its own manager, and these in turn are divided into farms each of which corresponds in name and roughly in size with one of the estates which occupied the area in the nineteenth century. Each farm is staffed with an overseer (sometimes also an assistant overseer), book-keeper and clerks. The lowest grade of supervisory workers are the headmen or drivers, who correspond essentially to the industrial foreman but are rather lower in status. Generally, the section managers, overseers and book-keepers are fair- or light brown-skinned Jamaicans; the headmen, like the workers themselves, are usually dark brown or black skinned. From junior book-keeper to section manager there is a fairly well organised ladder of promotion; but the writer does not know of any case of a headman becoming a book-keeper, the junior book-keepers being recruited from secondary and practical training schools.

It may be worth while noting the grouping of the estate buildings since it forms an important element in the social picture and expresses the essentially hierarchical social organisation of the labour force. At Frome the hub of the estate is the Compound, a park like expanse of several acres. At the northern end of this are the remains of the old stone 'works' close by the new factory and administrative offices, which are enclosed by a high thief- and riot-proof fence. A small hill overlooks the old works; it is crowned appropriately, by the house of the Internal Auditor, whose function it is to check expenditure on cultivation against the actual work done, and that of the overseer of Frome farm. Toward the southern end of the compound are the houses of most of the other central supervisory workers; the manager's stands on another low hill. Along the side of the compound which adjoins the main road are smaller houses for factory workers and foremen, and on the other side of the road more small houses are interspersed with the very simple cottages which house field workers. Each farm reproduces the pattern in miniature—a large house for the section manager on those farms which are the headquarters of sections, and accommodation in descending order of size and convenience for overseers, book-keepers and junior book-keepers. Scattered about the estate, sometimes adjacent to the farm offices, sometimes quite isolated, are rows of field workers' cottages; and here and there are settlements of small houses built by workers on estate land, less tidy but not necessarily less comfortable than those provided by the company.

Caymanas is a smaller estate and factory than Frome or Monymusk, but still larger than the average for the island omitting these two giants. The factory was built in 1930 with a designed capacity of 5,000 tons sugar; by 1943 the capacity had been expanded to 8,000 tons and the

manager and engineer have spent much ingenuity in bringing it up to its present level of about 12,000 tons. In 1952 the estate had 2,800 acres under canes (against 9,000 at Frome), reaped 91,000 tons of cane (Frome 272,000), bought in 9,000 tons of farmers cane (Frome 165,000) and produced 11,000 tons of sugar with an average figure of tons cane per ton sugar of 9.07, which is below the island average. In a sense Caymanas belongs to an older tradition than Frome, the owner being a descendant of the family that has held the estate for many years; its organisation is less elaborate and its atmosphere less formal than Frome. The section manager grade does not exist at Caymanas (or on most Jamaican estates), the overseers of the six farms being directly responsible to the field superintendent; nor does the separate post of business manager exist. The manager belongs to a family connected with the sugar industry for more than one generation—indeed his father once managed the same estate. Immediately under him are a factory manager and a field superintendent, the first a North of England man, the second a Hungarian with a Guianese background. Each of the farms has an overseer and book-keepers; two overseers were coloured Jamaicans and the others white at the time the estate was studied.

Caymanas is unique among sugar estates in the island in its nearness to Kingston. Its cane and banana lands lie on either side of the main road about nine miles from Kingston and four miles from Spanish Town; its backlands stretch for some distance into the hills toward Glade and Red Hills. These backlands are of vital importance to the estate since the rainfall on the canelands is too little for successful cultivation without the use in irrigation of the runoff from the hills. The property has grown considerably through the reclamation of swamp land, which is still going on. There are two other estates in the area—Bernard Lodge, which touches the southern boundary of Caymanas and reaches to the outskirts of Spanish Town; and Innswood, about five miles beyond Spanish Town on the road to Old Harbour. Caymanas and Bernard Lodge together form a single area of cane and banana land stretching from the hills on the north almost to the sea. The combined average weekly employment of these estates in the crop season is about 6,000, and they probably form the most important single industry in the Spanish Town area. Spanish Town itself was formerly the capital of the island, but has lost most of its old importance; its most considerable industries are the manufacture of logwood extract in one old-established factory and the weaving of cotton piece goods at a new factory outside the town on the Bog Walk road. The total population is about 12,000. On the other side of Caymanas, toward Kingston, a new industrial suburb is growing up on either side of the Kingston-Spanish Town main road, the furthest extension of which is at present about four miles from the Caymanas boundary. The estate is near enough to the city to feel the urban influence in its labour force, and Spanish Town, though not itself a town of any size, is in closer touch with Kingston than is any other town in the island. The labour

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force of Caymanas has probably been more deeply affected by urban ways of life and thought than any other estate in Jamaica, with the possible exception of Barnett, which is situated in and around Montego Bay. Even the peasants who come down from the hills to the north of the estate for seasonal work live in a district which contributes largely to the Kingston markets, and may travel themselves to the city to sell their produce and to spend the proceeds. One effect of the nearness of Kingston is that the 'compound' has a smaller influence than at Frome and the hierarchical organisation of housing and social life is less marked; there are many among the supervisory staff with strong social interests in Spanish Town and Kingston. Another effect has been to concentrate on Caymanas a disproportionate share of the labour troubles caused by the efforts of organisers of the Trades Union Council to find a foothold among the sugar field workers, efforts which have been bitterly resisted by the dominant union, the Bustamante Industrial Trades Union; since the T.U.C. (which has recently split into two unions) was mainly urban, with its greatest strength in Kingston, its natural point of attack was the estate nearest to Kingston, which is Caymanas.

Medically speaking malaria is one of the most important diseases in Jamaica, though its economic importance is hard to assess. Some data are presented here on its incidence in the Frome and Caymanas areas compared with that in the rest of the parishes in which these estates are situated, with a tentative attempt to translate some of these figures into terms of working time lost.

For the purposes of the present study a survey of malaria incidence among sugar workers in the Frome area of Westmoreland was carried out with the co-operation of the West Indies Sugar Company's medical staff at Frome Central. The primary object of the survey, to distinguish a group of workers whose blood showed the presence of malaria parasites in order to compare their work performance with that of a group free of malaria, was not achieved since the incidence over most of the survey area proved much lower than could have been foreseen. But a subsidiary object of the survey was to obtain information on the malaria incidence in the area compared with that shown by a previous survey in 1949, and on the relative incidence in different districts within the area.

The measure of malaria incidence used was the proportion of persons in each district whose blood showed infestation by malaria parasites. Blood smears were taken from a systematic sample of sugar workers and their families (not, it should be noted, of the general population) by an enumerator who visited the workers at their homes, and were examined in the laboratory attached to the Clinic at Frome Central. The sample was a subsample drawn from the larger sample of sugar workers used in the socio-economic survey, and selection was systematic at both stages, but the sample is believed to have been effectively random.

The percentages of positive slides for each district are shown in Table 15.

TABLE 15. MALARIA INCIDENCE IN FROME AREA, 1951

	Percentage of slides showing parasites	Standard error of percentage	Number of slides
District:			
Paul Island	0.00		78
Mount Grace	2.35	1.61	88
Petersfield	1.27	1.10	104
Georges Plain	2.54	1.92	67
Grange Hill	0.00		91
Total, above districts	0.96	0.47	428
Little London	22.83	3.78	123
Total, all districts	5.81	1.00	551

As the incidence varies with age, the above rates have been roughly standardised for age, the rate shown for each district being calculated by applying the rate observed in each ten year age group in that district to the age distribution shown by the whole sample.

One district shows a high incidence—Little London; the rates for all other districts are relatively low. Little London is the only district covered which has not been touched by the West Indies Sugar Company's spraying service (spraying of houses with gammexane preparations) and this may well be the explanation for this difference. It should be remembered, however, that Little London is a relatively marshy area, at least on the southeast.

The earlier survey, conducted in a similar way to that used in the present survey, fell within the districts recorded above as having a low incidence, and showed a general rate of about 9 per cent, so that a striking reduction in incidence appears to have taken place.

Some material on official malaria surveys carried out in 1950-51 has been made available to the writer through the courtesy of the Island Medical Office. In one, a Fever Survey, the procedure appears to have been to take a census of families in certain districts, collecting histories of 'fever' and recording the number who reported fever in the previous three months and the number who had fever at the time of the survey. From these persons with fever histories blood smears were taken and examined for the presence of malaria parasites; the number of slides examined did not, for various reasons, coincide with the number of fever histories obtained. Clearly such data cannot be made to yield absolute figures of incidence comparable with those given above, but they probably represent fairly well the relative malaria incidence in different districts.

TABLE 16. FEVER SURVEY 1950-51: WESTMORELAND PARISH

District	Population Census'd.	Number Persons reporting fever;		Persons reporting fever per 1,000 of population Census'd.		Number of positive smears	Positive smears per 1,000 pop. Census'd.
		Previous 3 mths.	Present	Previous 3 mths.	Present		
Savanna-la-Mar	3,569	125	9	35.0	2.5	10	2.8
Caneland Areas (a)	6,578	427	84	64.9	12.7	29	4.4
Little London (b)	637	91	40	142.9	62.8	17	26.7
Other districts	4,820	1,455	55	30.1	11.4	11	2.3

(a) Georges Plain, Burnt Savannah, Petersfield, Paul Island, Unity, Ferris, Friendship.

(b) Little London, Broughton, Old Hope

These results may be compared with those found by examination of school children:

TABLE 17. MALARIA SURVEY SCHOOLS, 1950-51; WESTMORELAND PARISH

Area	Number ex- amined for splenomegaly	Percentage with enlarged spleen	Number blood smears examined	Percentage positive smears	Positive smears as percentage no. examined for splenomegaly
Savanna-la-Mar	171	9.9	43	20.9	5.3
Caneland Areas (a)	656	22.4	177	11.3	3.0
Little London (b)	203	36.9	72	20.8	7.4
Other districts	480	11.3	70	11.4	1.7

(a) Georges Plain, Grange Hill, Paul Island, Mount Grace, Friendship, Petersfield, Ferris.

(b) Broughton, Little London.

These figures agree in showing the incidence for the caneland area as being higher than that for the rest of the parish, with the possible exception of Savanna-la-Mar, and the incidence for the Little London area is markedly higher than that for the rest of the lowland areas. The first point is not unexpected since the rest of Westmoreland outside the cane areas is hilly and malaria is known not to be a serious problem there; while the second point confirms the survey undertaken for the present study.

Similar figures are available for St. Catherine parish, in which Caymanas is situated:

TABLE 18. FEVER SURVEY, 1950-51; ST. CATHERINE PARISH

District	Population Census'd.	Number Per- sons report- ing fever		Persons re- porting fever per 1,000 of population		Number of Positive Smears	Positive smears per 1,000 pop. census'd
		Previ- ous 3 mths.	Pre- sent	Previ- ous 3 mths.	Pre- sent		
Spanish Town	4,351	90	38	20.7	8.7	9	2.1
Caymanas- Bernard Lodge	3,640	37	35	10.2	9.6	18	4.9
Other districts	13,450	215	38	16.0	2.8	20	1.5

TABLE 19. MALARIA SURVEY, SCHOOLS, 1950-51, ST. CATHERINE PARISH

District	Number examined for spleno- megaly	Percentage with enlarged spleens	Number blood smears examined	Percentage positive smears	Positive smears as percentage no. examined for spleno- megaly
Spanish Town	793	10.5	215	11.6	3.1
Caymanas-Bernard Lodge (Braeton, Gregory Park, White Marl)	205	29.3	125	12.0	7.3
Other districts	1,816	14.9	476	14.3	3.7

It can be seen that on the whole the figures here, too, indicate a higher malaria incidence for the cane area than for the rest of the parish.

It is not easy to translate medical statistics of malaria incidence into economically significant terms. The presence of parasites in the blood of an individual does not mean that he is undergoing a bout of fever or in any way experiencing an acute attack of malaria, since it is generally true that in a malarial country the population has a certain immunity to the parasite and the degree of infestation which is needed to produce an attack varies from person to person and is usually higher in areas where the disease is endemic. Conversely, the absence of the parasite does not mean that the subject is free from disease, since the parasites disappear from the peripheral blood stream periodically even in an acute attack. The figures obtained by the Medical Department's Fever Survey indicate that in the Westmoreland cane areas, including the Little London district, the proportion of the population who are suffering from 'fever' and whose blood shows the presence of malaria parasites is about 7 per mille. On the assumption that for various

causes this is only half the true figure, the proportion undergoing an acute attack of malaria, and so the proportion of working time lost from this cause, is only  $1\frac{1}{2}$  per cent. Since infestation is heavier among persons under working age, this figure may be an overestimate of the rate among the labour force. Such a proportion is obviously not of great economic importance. But the survey undertaken for the present study showed the proportion of the population in the same area in whose blood parasites are present to be 6 per cent. There is therefore a considerable number of workers at any one time who have the parasites in their blood but who are not suffering from an attack of malaria fever. There is unfortunately no means of assessing the effect on a person's work performance either of the presence of parasites in numbers too small to produce an attack, or of the possible damage to general health which may remain when an acute attack has subsided.

Some inference as to the general health of a population can sometimes be drawn from the average weights and heights of its members at each age. When this study was begun it was found that no satisfactory standard tabulation of heights and weights existed for even the school population of Jamaica. The raw material for such a tabulation for the Kingston and St. Andrew area existed in the record cards of elementary school children who had been examined in the routine health inspections, and these were made available for tabulation through the courtesy of the Public Health centres in Kingston and Spanish Town. They are based on the records of 5,000 children, a small number in comparison with, for example, the London County Council survey of 1938 (11), but sufficient to give a reasonably reliable standard. With these Kingston averages may be compared smaller numbers of children examined in three schools situated on the estates around Spanish Town, and attended largely by the children of sugar workers. The heights recorded in these schools are similar to those in Kingston, but the weights of the boys are, on average, 5 per cent lower and those of the girls 6 per cent lower. Standard errors were not calculated but on any reasonable assumption as to the coefficient of variation present the differences are unlikely to have arisen by chance. It is possible that the 'estate' schools include a higher proportion of East Indians than the Kingston schools and that these are constitutionally lighter at each age than the West Indians; but it seems more probable that the difference is due to inferior physical condition in a population of similar racial stock, reflecting either such sicknesses as hookworm or malnutrition. The proportion of East Indians in the Caymanas area, while higher than in Kingston, is probably not greater than 15 per cent; and for such an admixture to produce alone an average difference in weight of 5 per cent would imply an average inferiority in weight of the East Indian population of almost 20 per cent, which is absurd. On the other hand, hookworm is known to be common in the caneland areas, though its importance as an economic factor is hard to assess; and persons who live on and around the estates frequently express the opinion that the

sugar worker is inferior in physique and general health to the rest of the population, in spite of the fact that his work often develops in him an imposing musculature.

Certain features in the labour situation are common to Frome and Caymanas, and indeed all Jamaican estates. The peak of employment comes in the crop season, which occupies about six months of the year from January to June. The labour force consists of a nucleus of workers who find employment for most of the year, many of whom live on the estate or in villages near it, and a fringe of part time and seasonal workers who are employed for very varying periods, some for as little as one week in a year. Only a minority of workers enjoy any security in their jobs, in the sense that they can be confident at the end of one week that they will return to a given job at the beginning of the next. Most work is given out at the beginning of the week; the workers presenting themselves for employment assemble and the available work is shared out by the book-keeper so as to form a week's task for as many as possible. Under such a system, with no continuous record kept of the individual worker, it is clear that the relation between the effective employer, that is, the overseer or his immediate superior, and the field worker, must be of a peculiarly casual sort. The worker in the sugar factory stands in a closer relation to his supervisor and his position is more stable; he may be laid off in the out of crop season but while employed he is assured of work of a predictable kind in a known place, and this will be the more true the greater his skill. The present study, however, is not primarily concerned with the factory worker, and the general background of what follows must be conceived as one of mass unskilled labour and seasonal unemployment.

During crop the factory functions as a single process with its speed governed by the mechanical equipment and the continuity of supply of cane. There is little opportunity for the intensity of work of the individual operative to be increased or diminished by his own volition. To devise a measure of productivity in these circumstances would be difficult. The extent to which the throughput of material per worker is governed by the capital equipment, and in particular by the scale of operation, may be seen from the data quoted in an earlier section on the relation between input and efficiency in Jamaican sugar factories. In these circumstances attendance might be taken as a partial measure of efficiency; some data on attendance for Caymanas factory in 1949 have been recorded and show that absenteeism in the crop season is extremely low, the percentage of mandays lost through absence in the first four months of crop, when the factory was working seven days a week, being less than two per cent. Out of crop the figure is higher, but since the work is not then done on a full time basis this is of less practical importance. In any case, it was shown in an earlier section that in sugar manufacture the wage bill accounts for only about 11 per cent of the total costs, being relatively insignificant compared with material costs (70 per cent). The labour problems raised by the

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factory worker are therefore slight and inexpensive compared with those occurring on the field side of the industry.

In both the Frome and Caymanas areas there are well-marked social differences between the sugar labour force and the general labour force of the parish. In the Caymanas area this can be demonstrated from material extracted from the schedules of the 1943 census (see Appendix). In the census districts in Spanish Town and immediately adjoining Caymanas there were recorded 881 male and 335 female sugar labourers. 62 per cent of the men and 53 per cent of the women had been born outside St. Catherine parish. Only 19 per cent of the general population of the parish were born elsewhere. Over half of the sugar workers who were immigrants came from the four parishes which lie to the west of St. Catherine on the south coast of the island, Clarendon, Manchester, St. Elizabeth and Westmoreland. This suggests that Spanish Town forms a halting place for migrants travelling along the road from the western parishes to Kingston.

A common accompaniment of migration is the weakening of family bonds. In Jamaica the family exists in three main forms. The most stable is that founded on legal marriage, and this is undoubtedly the form looked on as the ideal by most Jamaicans. But for reasons which are still in dispute it is slightly less common in the general population than "common-law" marriage, which at its least stable may be little more than a casual arrangement lasting a few weeks and at its other extreme is distinguishable from a successful formal marriage only by the absence of the marriage ceremony. The breaking up of a common-law partnership naturally leads to the establishment of families of a third type which include a single woman and children with no permanent male member. It is broadly true that the prevalence of legal marriage in a Jamaican community is an index of the degree of stability of the family in that community. (This does not imply that legal marriage is either a sufficient or a necessary condition of stability.) Among the sugar workers recorded by the census in the Spanish Town-Caymanas area the percentage of persons formally married was lower at all ages than in the general population of the parish; for men over 50 it was 19 per cent, and for women over 50 10 per cent, against 48 and 33 per cent for the whole parish. It seems reasonable to regard these figures as supporting the general observation, that the degree of stability of family life is less in the sugar labour force than in the general population.

The same points can be shown to be true for the Frome area from material collected in the field work for the present study. A systematic sample of one household in ten was taken over the areas from which is drawn the greater part of the estate's labour force, and information was collected on the composition of the family and other personal circumstances of those households a member of which had worked on the estate in the preceding six months. (This information was later correlated with information on earnings as described below.) The survey

covered 600 households containing 760 sugar workers. These workers may be divided according to their place of residence into three types; those who come from predominantly peasant districts outside the cane lands, those who live among the canefields and those who live in the villages (Grange Hill, Petersfield, Little London, Frome Village). The first type are similar socially to the general population of the parish; the urban and caneland types are more typically sugar workers. Among the former 16 per cent were born outside Westmoreland; among the latter, 35 per cent. This high proportion of immigrants is the more striking since Westmoreland is not, like Spanish Town, astride a main migration route to the city and the only employment opportunity for immigrants is in the sugar industry. The proportion of households founded on a legal marriage in the peasant group is not significantly greater than among the other groups as far as the skilled and semi-skilled workers are concerned, (53 against 46 per cent), but among labourers the percentages are 35 and 17. In the Frome area too, therefore, the sugar labour force can be described as relatively rootless and socially disorganised.

The most ambitious survey yet made of the Jamaican sugar field labour force was that carried out by the Jamaica Labour Department in 1944 in connection with the work of the Committee on the Sugar Industry in Jamaica (10). Theoretically, the method used was to take a systematic sample of one worker in four in the field side of the industry, very full information being obtained on the family background, earnings and work history of those workers covered. The usefulness of the study is limited as a description of the whole labour force of the industry by the method of taking the sample; it was based on the workers employed in a single week in the crop season, and it does not seem to have been realised that this led to a very serious underestimation of the number of part time workers and of the total number of workers who found employment at some time during the year. Moreover the tabulation of the material, like all official statistical work in Jamaica, was handicapped by lack of staff and equipment and a great deal of information was not published; this would have been less regrettable had the schedules been preserved for further work later, but they seem to have been inadvertently destroyed.

The bias introduced into the results by the method of sampling may be illustrated by some figures for Frome in crop, 1944. The published figures imply that during a crop period of 20 weeks, just over half the labour force worked every week, and only 8 per cent worked less than ten weeks. When the bias is eliminated the percentage who worked less than ten weeks is 21, and the median number of weeks worked is not 20 but 17. Similarly for the whole industry the percentage working less than the ten weeks in crop is given as 11, whereas a more correct figure would be 25. The average number employed in crop is given as 23,700 and the peak figure in any one week as 30,300; the total number who find employment in some week of crop can be

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calculated as about 42,000. This implies that the total labour force attached to the industry is substantially larger than has usually been thought. An illustration of this occurred recently at Frome when the form of the field pay records was changed from the cumbersome weekly payrolls to a system of individual record cards. The number of cards provided on the basis of the accepted number of registered sugar workers was found to be too small to meet the need by about 3,000. The average employment at Frome during 1950 (field only) was 7,500, and assuming that the composition of the work force in respect of the number of weeks worked was the same as in 1943 the number who found work there at some time in crop was 10,800. There are probably few who worked in the out of crop season and did not do so in crop, so that this may be taken as the total annual labour force.

The survey done for this study found 760 sugar workers in the area, in a one in ten sample, giving a total of 7,600 ( $s (%) = 5$ ). The area almost certainly includes the majority of the factory workers (average crop employment 900) and allowing for some underenumeration the number of field workers in the survey area may be put at 7,000. Since the total field labour force has been shown above to be about 10,800, almost 4,000 workers must come from outside the survey area to work at Frome in crop. These are mainly peasants from the hills of Westmoreland, Hanover and St. Elizabeth who travel down for a few weeks in crop, usually to act as cane cutters. As an example of the kind of community which contributes these workers, we can take the district of Porter's Mountain which was covered by the survey. From one polling division here, with a population of about 400 adults, a sample of one in ten households gave 26 sugar workers; two of these were women and worked as weeders; one man of 65 worked at cleaning cane, and the rest as cane cutters. 18 worked on the same farm, Belle Isle. The community lies in a triangular pocket in the hills, reached from the estate by a long and circuitous road unsuitable to any vehicle less robust than a jeep; but in a direct line it is only four miles from the nearest farm, and a bridle path runs across the spine of hills which the parochial road is forced to circumvent. All those who travel down to work in the cane fields in crop are also farmers or skilled workers. It is a prosperous peasant community in whose life the habit of migration in search of wage work is firmly established, and a high proportion of its families have members or relatives working in Kingston.

The considerable social differences between the peasant who is also a labourer and the worker from the caneland area are further illustrated by these points from the survey results. The proportion of workers from the village and caneland areas who have cultivations is only 49 per cent, against 74 per cent in the peasant areas, and the average distance from the worker's home to his cultivation is greater since the majority of the land available for small holdings lies outside the cane area. The proportion owning the houses they live in is higher in the peasant areas (65 per cent) than the village and peasant areas

(42 and 49 per cent) and the average number of years the family has been resident in the house is longer (10.2 against 6.5 and 7.1). Among the unskilled labourers the average school leaving age is slightly lower among the peasant group (11.2 years) than among the others (11.5, 12.3 years).

The field work at Caymanas did not include a survey of the whole sugar area and we cannot speak with the same confidence of its labour force. The average field employment in 1950 was 1,400 and in the factory 300 with a combined peak figure in crop of about 2,400. A considerable number of the workers were drawn from Spanish Town; in 1944 the percentage among field workers was 17. It was higher among the cutters, who work chiefly in crop (25 per cent) and in 1950 when a study was made of the cutting gang on Caymanas farm (the 'home farm' of the estate, adjacent to the factory) half of these were found to live in Spanish Town. 36 per cent of field workers were resident on the estate; this percentage falls in crop with the influx of outside workers. The remainder lived in villages and settlements on the borders of the estate (such as Central Village, a collection of shacks on the main road which provides a high proportion of the weeders) or came from the countryside around. The most distant points recorded were Kingston and Sligoville (10 miles). The proportion of workers who had a cultivation was much lower than at Frome: in 1944 it was 11 per cent, but it is probably lower now. Small plots were formerly made available to regular workers but the policy later became to withdraw these and discourage cultivation in the hills which provide the estate's supply of irrigation water, in order to prevent erosion and make more efficient use of the land. The proportion who own, rent or lease land for a 'house-spot', possibly with a small garden attached, is somewhat higher—30 per cent in 1944, and 20 per cent in 1950 among the workers of the Caymanas farm.

In order to understand the results of the field work done in the Frome area and to assess their validity it is necessary to know something of the procedure used and the statistical analysis applied to the data obtained. The object was to obtain general social and economic information about a representative sample of sugar field workers employed by the West Indies Sugar Company in order to examine the relation between differences in earnings from worker to worker and differences in socio-economic background. The method used was to carry out a questionnaire survey through enumerators of a systematic sample of one household in ten in the area in which the labour force of the estate was known to be concentrated.

One of the first problems met was the impossibility of obtaining a satisfactory frame which would include only sugar workers. Since the survey must include at some point a survey or census of the whole population of the area in order to distinguish sugar workers from the rest, the cost of the survey in a given area per unit of information obtained for final use would vary inversely as the proportion of sugar

workers in the population of the area. It was therefore economically necessary to confine the survey to an area in which the concentration of sugar workers was high. In order to delimit such an area, and also to find out how sharply its limits could be drawn, an examination was made of the worksheets of the 'Survey of Economic Conditions among Sugar Workers' made by the Jamaica Labour Department in 1944. Had the proportion of sugar workers in the population fallen off gradually as one moved away from the centre of the cane area, with no clear threshold between the estate itself and the rest of the parish, it would have been difficult to set a boundary to the area to be covered and the setting of an arbitrary boundary would have introduced an inassessable bias. In fact it appeared that the majority of the estate's labour force was drawn from an area with well-defined boundaries and the survey was largely confined to this area.

The boundaries adopted, roughly speaking, consist of the Bluefields-Savanna la Mar-Negril road on the south, and the 250 ft. contour line on the west, north and east. In order to obtain information on the workers from outside this area, three hill districts and one coastal district were also covered.

For various reasons, most of the conventional types of frame proved unsuitable for the survey. The most recent census information was eight years old, and portions of the schedules for the district had been lost or damaged. Electoral rolls for the area had just been newly compiled, but in the circumstances of rural Jamaica it is seldom possible to include in the roll any address more precise than that of the post office where mail is collected, and this would place an inordinate burden on enumerators in finding the individual they wished to interview. Some kind of geographical frame therefore seemed the most suitable.

Where a survey has to be conducted on a geographical basis in an area where large scale maps are not available, one preferred procedure is a preliminary numbering of houses in order to form a frame from which a systematic or random sample can be drawn. This was not adopted in this case for certain special reasons. Such a procedure in rural Jamaica would draw popular attention to the survey before it could be fully begun; and the atmosphere of the Frome area at the time of the survey was disturbed by recent labour troubles and the pending distribution of a retroactive pay increase, so that the survey might have been misinterpreted as either some move by the management of the estate directed (no matter how obscurely) against the workers, or as some kind of official survey of living conditions on which a further wage increase would be based. Since such interpretations would arouse resistances and biases among the correspondents, and since an undertaking had been given to the estate management that the survey would be so conducted that it would not affect their relations with their workers, it seemed best to adopt a procedure which would call as little attention as possible to the survey and leave no time between successive visits of enumerators in which doubts and suspicions could take shape in the

minds of the workers. The method used was therefore to arrange for enumerators to move systematically along all roads and tracks in the area obtaining information from every tenth house, starting from one randomly selected, with variations devised to take account of groups of houses lying away from roads or tracks. Such a procedure is more likely to avoid serious bias if the proportion of houses which do not lie on a road is small; and this condition is fulfilled in the candeland areas since the interior of most 'blocks' is occupied by the canefields.

A set of maps was prepared for enumerators from the Topographical Survey (1948), amplified by older maps so far as place names were concerned and checked and corrected on the ground.

The procedure gave a systematic sample of one house in ten. There seems little risk of bias being inherent in such a procedure in rural conditions, and it is believed the sample was effectively random. Since the house has been used as the unit of analysis, it would be strictly advisable to apply correction to the results to allow for the presence of houses containing more than one household or worker. Inspection of the returns suggested that the possible bias from this source would be so small that it would not be economic to take account of it in the sorting procedure.

The sampling procedure adopted threw a considerable burden on the enumerator since he had the responsibility of seeing that the sampling interval was observed. Thirty enumerators were employed, who may be divided into three groups. The greater part were school teachers from the local elementary schools, and the fact that they proved for the most part satisfactory enumerators, in spite of inexperience, is to be attributed mainly to the careful supervision given to them by the head teachers of the schools which cooperated. In one area a small group of young men recommended by the head teacher and supervised by him, did the work satisfactorily. Finally, two older men were employed, of whom one dealt with some areas of special difficulty and also acted as enumerator in the malaria survey carried out on a sub-sample of workers.

All enumerators were given a map of their district, a description of all roads within it and a mimeographed sheet of general instructions; and were interviewed and given further explanations of the instructions before beginning work. Under a sampling scheme of the type used there is some temptation to the enumerator who finds the house indicated by his instructions empty or difficult to reach to substitute an 'easy' alternative; and it was impressed on enumerators that when that or similar situations arose they must not make their own choice but refer to headquarters for instructions. General observation of their work in the field, and sample checking of their results, indicate that they kept to their instructions faithfully.

The questionnaire used was designed to be as simple as was compatible with the aims of the survey. It was judged that beyond certain limits an attempt at the exhaustiveness and verbal precision desirable

in a more literate country would defeat themselves by arousing resistance, and since the aim was to obtain information which would meaningfully distinguish groups of workers questions were used which served as indices rather than explicit statements of social distinctions. Thus instead of attempting to assess a worker's mobility from a full statement of his migration history, it was only asked where he was born.

Through the courtesy of the officers of the Sugar Industry Labour Welfare Board and of the manager of the estate, the Welfare Office at Frome central was used as the main headquarters of the survey, and enumerators either reported there or at the schools which served as local headquarters and were visited frequently. Most enumerators completed their assignments in two weeks, but since some of the peripheral areas were done later than the rest the whole survey took about six weeks.

When the main survey had been completed a subsample of sugar workers was examined for the presence of malaria parasites in the blood. Smears were taken by an enumerator trained for the occasion at the estate clinic, the collection taking a further two and a half months after the main survey ended. The examination of the blood smears was done in the laboratory attached to the estate clinic. The results obtained are discussed elsewhere in this paper.

Information on the earnings of the field workers in the sample was taken from the records of the West Indies Sugar Company. At first it was hoped to obtain week-by-week histories of the earnings of each individual, but this proved an impossibly laborious task in spite of the co-operation of the Company's staff. A retroactive wage increase had made it necessary for the Company to compile a record of each worker's total earnings in the period 12/12/50—16/6/51, and these totals were the ones finally used. At this time the Company's wage records consisted of the weekly paybills made out for each farm, with the workers' names recorded in alphabetical or arbitrary order, and the practical difficulty of extracting week-by-week information on an individual was very great. Since then a system of individual record cards has been adopted which makes the extraction of such information very much easier.

All data were hand sorted after being typed in coded form onto plain cards. A first tabulation was made of the questionnaire data by transferring the information for each household to a card and hand-sorting these. Questionnaires referring only to skilled and supervisory workers were then eliminated and the data for unskilled field workers carded, one card to each worker, and the earnings data added. Workers whose names could not be located in the earnings records had necessarily to be omitted from the later stages of the analysis. These amounted to about ten per cent of those who had reported themselves as unskilled field workers, and the majority of these are believed to have given false information in that they stated that they had been employed by the West Indies Sugar Company during the survey period when in fact they had not.

The analysis of the data was designed to answer two questions: Did the workers in different social categories show significant differences in mean earnings? and if so, what was the pattern of these differences?

It was necessary to apply a transformation to the data to bring them into a form suitable for variance analysis. The distribution of the crude data, that is, the total earnings in £ of each worker over the period 12/12/50—16/6/51, was skew, approximating a Poisson distribution. The application of a square root transformation and multiplication by an arbitrary factor brought the distribution close to the normal. It will be seen that this process does not eliminate a tendency for the means and variances of subgroups to be proportional, but this is believed to be partly due to factors inherent in the data other than non-normal distribution and not to invalidate the application of variance analysis.

Preliminary analysis showed that the most significant distinctions in the data were likely to be the following:

- a. Family situation. The grounds of distinction here was the varying degree of responsibility for the (cash) maintenance of other members of the family associated with various types of household and positions of the worker within the household. The following categories were distinguished for purposes of analysis;

Head of household based on a legal marriage.

Head of household based on a common-law marriage.

Single person living alone.

Other situations.

- b. Age. The following age groups were distinguished:

Under 35 years.

35 to 49 years inclusive.

Over 49 years old.

- c. Ownership of a house and/or cultivation. Households owning either house or cultivation were distinguished from those owning neither.

- d. Educational standard. Workers who left school before the age of 11 were distinguished from those who left at a later age. Those who never attended school were included with the first category.

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TABLE 20. AVERAGE EARNINGS ACCORDING TO AGE AND FAMILY SITUATION

Earnings of male sugar field workers, Frome, Jamaica, for seven months, 1950-51, classified by age and family situation.<sup>a</sup>

	Age:			
	Under 35.	35-49.	Over 49.	All ages.
Family Situation:				
Head of legally married family.	5.52 (21)	4.84 (41)	4.55 (15)	4.97 (77)
Head of commonlaw family.	5.64 (53)	4.92 (40)	4.75 (4)	5.30 (97)
Single person living alone.	4.62 (27)	5.07 (9)	3.63 (3)	4.65 (39)
Other family situations.	3.97 (69)	3.96 (8)	4.32 (10)	4.01 (87)
All family situations.	4.78 (170)	4.82 (98)	4.42 (32)	4.76 (300)

Earnings of female sugar field workers, Frome, Jamaica, for seven months, 1950-51, classified by age and family situation.

	Age:			
	Under 35.	35 - 49.	Over 49.	All ages.
Family Situation:				
Legal wife of head of household.	2.74 (11)	3.51 (15)	4.00 (4)	3.29 (30)
Commonlaw wife of head of household.	3.27 (38)	3.25 (14)	1.70 (2)	3.20 (54)
Single person living alone.	2.12 (5)	1.60 (3)	3.23 (3)	2.28 (11)
Other family situations.	2.69 (30)	3.61 (24)	3.24 (13)	3.13 (67)
All family situations.	2.92 (84)	3.38 (56)	3.24 (22)	3.12 (162)

<sup>a</sup> The measure of earnings in this and subsequent Tables is based on a square root transformation of the worker's earnings in £ in the period 12 December, 1950-16 June, 1951.

Figures in parentheses show number of workers on whom mean is based.

The male workers were the main object of the study, and the number of female workers covered was too small to permit satisfactory testing of the significance of differences between categories. A preliminary analysis of the data on female earnings given in Table 20 is as follows:

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	P
Total	341.28	161			
Within subclasses	306.62	150	2.04		
Between subclasses.	34.66	11	3.15	1.5	0.15

Since the variance of the subclass means does not approach significance the analysis was not carried further.

A preliminary analysis of the male earnings data in Table 20 gives the following results:

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	P
Total	1385.48	299			
Within subclasses.	1274.78	288	4.43		
Between subclasses.	110.70	11	10.06	2.3	0.03
Between rows (family situation)	82.01	3	27.34	6.18	Less than 0.01
Between columns (age)	4.26	2	2.13	Not significant	

Inspection of Table 20 suggests that there is interaction present, largely because the category 'other situations' is not homogeneous; in the lower age groups this category consists mainly of dependent members of families, in the higher age groups of the heads of broken or denuded families. Calculation of this interaction through the method of fitted constants gives the following:

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	P
Interaction	49.55	6	8.26	1.9	0.08

Calculation of the variance associated with family situation and age allowing for the presence of interaction, by the method of weighted squares of means, gives the following:

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	P
Family situation	26.16	3	8.72	2.0	0.12
Age	8.07	2	4.04	Not significant	

The classification by three categories of age and four categories of family situation divides the data into twelve subclasses. The differences between the mean earnings in these subclasses are significant at the 5 per cent level, which in material of this type can be taken as a reasonable surety that they have not arisen by chance. These differences can be analysed into three components: first, the differences between the means of the rows; second, the differences between the means of the columns; and third, an effect specific to a particular combination of age and family situation. Of these three components none taken independently is significant at the 5 per cent level, and the third approaches this level more closely than the other two.

The answer to the second question asked above—'what is the pattern of the differences in earnings?'—is therefore not a simple one. The most obvious possibility is to adopt as a model an equation of the type

$$a^j + b^k + x = x^{jk}$$

where  $a^j$  and  $b^k$  are constants associated with row  $j$  and column  $k$  respectively, or a simple variant of such an equation. But the magnitude of the interaction term in the analysis of variance suggests that such an equation will fail to account for an important component in the variance of the subclass means. Inspection shows that the greatest positive deviation from the overall mean occurs among the legally married and commonlaw workers under 35 years old, and the greatest negative deviation among the 'other family situations' under 50 years old, but some means of distinguishing more accurately among the other subclasses would be desirable, and in particular one based not only on the subclass means but also on the numbers within the subclasses.

In an attempt to meet this problem the following working device was adopted. The values of it were calculated for the differences of each subclass mean from each other subclass mean and the resulting values of  $P$  were arranged into a matrix so as to maximise the values along the principal diagonal. The association of neighbouring cells into groups having high values of  $P$  among themselves and low values as with other groups gives the following classification:

Group consisting of neighbouring subclasses in Table 20	Number of Workers	Average earnings.	Variance.
A. Heads of legally married and commonlaw households under 35 years old	74	5.60	5.34
B. Heads of legally married and commonlaw households between 35 and 49	81	4.88	4.29
C. Single person living alone under 50 years old	36	4.73	4.03
D. All family situations, over 49 years old	32	4.43	3.51
E. 'Other family situations' under 50 years old	77	3.96	3.87

This analysis suggests that in the highest age group the earnings of the worker are not greatly affected by his family situation. At lower ages, and particularly below the age of 35, married workers earn on an average more than single workers living alone, and single workers living alone earn more than workers who are still dependent members of their parental household. The difference in mean earnings between the highest-earning group, the married workers under 35, and the lowest-earning group, dependent workers living in the parental

household, is 40 per cent in terms of the transformed data or about 100 per cent in terms of the crude data.

TABLE 21. EARNINGS ACCORDING TO POSSESSION OR NON-POSSESSION OF LAND

Earnings of male sugar field workers, Frome, Jamaica, for seven months, 1950-51, classified by family situation and possession/non-possession of house or land.

	Workers belonging to households:		Probability of difference arising by chance.
	Owning house or land	Owning neither house nor land	
Family Situation:			
Head of legally married family	4.47 (52)	6.01 (25)	P = 0.01
Head of commonlaw family	5.00 (44)	5.55 (53)	P = 0.30
Single person living alone	4.53 (10)	4.69 (29)	Greater than 0.50
Other family situations	3.95 (61)	4.14 (26)	Greater than 0.50
All family situations	4.42 (167)	5.17 (133)	P = 0.01

Earnings of female sugar field workers, Frome, Jamaica, for seven months, 1950-51, classified by family situation and possession/non-possession of house or land.

	Workers belonging to households: Owning house or land.	Owning neither house nor land.	Probability of difference arising by chance.
Family Situation:			
Legal wife of head of household.	2.82 (16)	3.82 (14)	P = 0.08
Commonlaw wife of head of household.	3.33 (24)	3.19 (30)	P = 0.50
Single person living alone.	2.30 (2)	2.28 (9)	P greater than 0.50
Other family situations.	3.09 (36)	3.17 (31)	P greater than 0.50
All family situations.	3.09 (78)	3.16 (84)	P greater than 0.50

Figures in parentheses show number of cases on which mean is based.

Among both male and female field workers, those who own neither

house nor land have higher earnings on the average than those who own either of these, and among the male workers this difference is significant. It is much more marked, however, among the heads of married families, and to a less extent among the heads of commonlaw families, than in the other categories. Similarly, among the female workers it approaches significance only in the category 'legal wife of head of house'.

TABLE 22. EARNINGS ACCORDING TO EDUCATION AND FAMILY SITUATION.

Earnings of male sugar field workers, Frome, Jamaica, for seven months, 1950-51, classified by family situation and age of leaving school.

	Workers in households whose head left school:		Probability of difference arising by chance.
	Under 11 yrs.	At 11 or over	
Family Situation:			
Head of legally married family.	5.03 (25)	4.94 (52)	P greater than 0.50
Head of commonlaw family.	4.56 (33)	5.69 (64)	P = 0.05
Single person living alone.	5.35 (11)	4.38 (28)	P = 0.17
Other family situations.	3.67 (28)	4.16 (59)	P = 0.30
All family situations.	4.51 (97)	4.87 (203)	P = 0.19

Earnings of female sugar field workers, Frome, Jamaica, for seven months, 1950-51, classified by family situation and age of leaving school.

	Workers in households whose head left school:		Probability of difference arising by chance.
	Under 11 years	At 11 or over	
Family Situation:			
Legal wife of head of household.	2.56 (15)	4.02 (15)	P = 0.02
Commonlaw wife of head of household.	3.24 (16)	3.25 (37)	P greater than 0.50
Single person living alone.	1.90 (4)	2.50 (7)	P = 0.30
Other family situations.	3.44 (28)	2.85 (38)	P = 0.10
All family situations.	3.08 (63)	3.15 (97)	P greater than 0.50

Figures in parentheses show number of cases on which mean is based.

The classification of workers by educational standard of the head of the household does not yield results of clear significance. On the whole workers with a higher educational standard, as measured by school leaving age, have the higher earnings among both men and women, but the differences are small. Differences significant at the 5 per cent level occur among male workers in the category 'head of commonlaw family' and among female workers in the category 'legal wife of head of household', and in each case are in favour of the workers with the later school leaving age.

It should be noticed that the age of leaving school is that of the head of the household, not necessarily that of the worker. Among male workers the two usually coincide, but this is not true among the married female workers. Comparison of the corresponding categories of the male and female tables suggests that among legally married workers the wife's earnings tend to depend markedly on the husband's degree of education, while the husband's earnings do not. Among the commonlaw workers the husband's earnings vary with his standard of education, while the wife's are relatively independent of it. If it is permissible to take the sum of corresponding means from the two tables as indicating the combined income of married households, we may restate this in another form: the household income for married and commonlaw husbands is greater where the husband's standard of education is higher, but the proportion of the household income contributed by the wife in a legally married household varies with the husband's standard of education to a greater extent than is true of a commonlaw household. In Jamaica legal marriage is traditionally differentiated from commonlaw marriage by the fact that the legal wife is less often expected to contribute to the income of the household by her earnings in an outside occupation. The results quoted here may perhaps be taken to suggest that this differentiation is less fully accepted by the more educated workers.

The general results of the field survey may be compared with an analysis, made before the survey, of information from the schedules of the census of 1943. Among the items recorded on the census schedules was the worker's own report of his earnings in the week ending 12 December, 1942. Table 22 below gives the average reported earnings of all male labourers in cane cultivation whose racial type was recorded as 'black', from three census districts adjacent to Frome central, classified by marital status and age. The categories of marital status which can be extracted from the census schedules have a reasonably close correspondence with those used in the field survey.

In some ways the data on which this analysis is based are less homogeneous than those of the field survey; for example, they include any canefield labourers who worked for independent cane farmers. In one respect they are more homogeneous, since the fact that they are drawn from the immediate vicinity of Frome factory means that they

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TABLE 23. AVERAGE EARNINGS OF SUGAR LABOURERS IN THE FROME AREA IN THE WEEK ENDING DECEMBER 12, 1942. (Shillings)

	Marital Status:				All Statuses:	
	Single— Depen- dent	Single— Head of house- hold	Common- law marriage	Legal marriage	Uncor- rected Mean	Cor- rected Mean
Age:						
Under 25.	8.6 (122)	8.5 (30)	8.0 (14)	11.0 (3)	8.6 (169)	8.9
25 - 49.	8.1 (56)	9.3 (79)	9.0 (189)	9.4 (50)	9.0 (374)	8.9
50 and over.	7.0 (3)	7.5 (35)	8.0 (26)	10.3 (47)	8.8 (111)	8.4
All ages:						
Uncorrected mean.	8.4 (181)	8.7 (144)	8.8 (229)	9.8 (100)	8.8	
Corrected mean.	8.4	8.8	8.8	10.1		

Figures in parentheses show number of workers on whom mean is based. Corrected means have been adjusted for non-orthogonal distribution of cases in cells.

include few part-time cultivators. This may explain the fact that legally married workers earn decisively more than commonlaw workers (as at Caymanas) whereas the field survey showed little difference between the groups (see above). In the light of the fact that the census data have a different basis from those of the field survey and were never intended for intensive analysis, the correspondence between the two sets of results is reasonably close.

The census data showed a strikingly consistent superiority in earnings among those who had received a primary schooling as against those who had received no education (there were no workers with more than primary schooling). This is in contrast with the results of the field survey, which showed no consistent difference.

TABLE 24. AVERAGE EARNINGS OF SUGAR LABOURERS IN THE FROME AREA IN THE WEEK ENDING DECEMBER 12, 1942. (Shillings)

	Marital Status:				
	Single— Depen- dent	Single— Head of house- hold.	Common- law Mar- riage.	Legal Mar- riage.	All Statuses.
Standard of Education:					
No Schooling.	7.1 (75)	7.7 (83)	8.1 (147)	9.0 (49)	7.9 (354)
Primary Schooling.	9.4 (106)	10.1 (61)	10.1 (82)	10.7 (51)	9.9 (300)

Figures in parentheses show number of workers on whom mean is based.

The Caymanas study was intended as a pilot study for wider development later; it was carried out as simply and cheaply as possible, and its mechanics can be described much more briefly than was the case for the Frome survey. The study was limited to the labour force of Caymanas Farm, the 'home' farm of the estate, and covered 147 workers. Questionnaire information on the social background of each worker was collected by a single enumerator; earnings data were taken from the farm paybills. The survey period for earnings was the crop period 1950 for the cutting gang, and for other workers eight weeks immediately after the end of crop. Owing to the small number of workers covered and the fact that all appeared on the same paybills it was possible to analyse the earnings data in more detail than was done later at Frome. The relative work performance of the labourers and weeders was measured by their total and average weekly earnings and those of the cane cutters by two indices called below index of performance and index of variability. The first represents the average of the weekly values for each cutter of his output of cane cut, expressed as a percentage of the average tonnage cut by all workers in each week. It may be regarded as a cutter's average output after allowance has been made for the fact that the tonnage of cane to be cut varies from week to week through causes external to the worker. The index of variability is based on the weekly index of performance and represents the range in the weekly values of the latter index for a given worker expressed as a percentage of his average index of performance.

TABLE 25. AGE DISTRIBUTION OF WORKERS, CAYMANAS  
Sugar field workers, Caymanas Farm, Caymanas, Jamaica, 1950, classified by age and work groups.

	Age Group:				All ages
	Under 30	30 - 39	40 - 49	50 and over	
Work Group:					
Cutters	11	21	14	6	52
Labourers	17	24	17	12	70
Weeders	12	10	14	11	47
All work groups	36	44	39	28	147

The analysis of variance applied to the Caymanas pilot study was more exploratory and less systematic than that applied to the Frome survey and the results are not given here in full. They are covered in detail in an unpublished paper on file at the Institute of Social and Economic Research. In regard to age, the results suggest a relation between age and work performance, but do not confirm the statistical significance of the differences involved except in the case of the weeding gang.

Generally, weekly output appears to be relatively low in the ages

TABLE 26. EARNINGS ACCORDING TO AGE GROUPS.

Earnings, or performance and variability indices, of sugar field workers, Caymanas Farm, Caymanas, Jamaica 1950, classified by age and work groups.

	Age Group:				All ages
	Under 30	30 - 39	40 - 49	50 and over	
Cutters:					
Performance index	90	104	106	99	101
Variability index	85	69	79	83	77
Labourers:					
Total earnings <sup>a</sup>	235	229	252	183	228
Average earnings <sup>b</sup>	31.1	30.3	34.0	24.4	30.4
Weeders:					
Total earnings <sup>a</sup>	127	153	119	115	128
Average earnings <sup>b</sup>	17.2	19.5	18.3	15.4	17.7

<sup>a</sup> Total earnings in shillings during eight week period 2.7.50-26.8.50.

<sup>b</sup> Average weekly earnings in shillings for weeks in work during period.

20-29, reaches its peak in the decade 30-39, is still relatively high in the next decade of age but declines markedly above the age of 50. A deviation from the pattern occurs among the labourers, where the earnings of the age group 20-29 is raised by the inclusion of a small number of East Indians with particularly high earnings.

TABLE 27. EARNINGS ACCORDING TO FAMILY TYPE.

Earnings, or performance and variability indices, of sugar field workers, Caymanas Farm, Caymanas, Jamaica, 1950, classified by family type and work group.

	Family Type:				All Types
	Legal Marriage	Common-law Marriage	Parental Family	Other Types	
Cutters:					
Performance index.	125	101	87	—	101
Variability index.	65	77	84	—	77
Labourers:					
Total earnings <sup>a</sup>	311	212	199	229	228
Average earnings <sup>a</sup>	40.1	28.8	26.8	28.8	30.4
Weeders:					
Total earnings	116	130	135	127	128
Average earnings	19.4	18.4	17.2	17.1	17.7

<sup>a</sup> See notes, Table 26.

For the purposes of the Caymanas study workers were divided into four groups according to their family type, the classification being based on the relationship of the worker to his principal dependent. The great majority of workers could be classified as belonging to legally

married, commonlaw or parental families, the latter meaning that the worker's principal dependent was his father, mother or other relation of an older generation. This classification is different from that used later at Frome but is based on the same fundamental distinction, the degree of financial responsibility for other members of the family associated with different family forms.

Among male workers (cutters and labourers) the differences between family types are significant at the 5 per cent level and follow a uniform pattern. Earnings, or the index of performance, are highest in the category 'legal marriage', lower in the 'common-law' category and lowest in the 'parental family' category, with the small number of other types falling between the two extremes. Among the weeders (women) the patterns of total and average earnings run contrary to one another and no clear trend emerges.

TABLE 28. EARNINGS ACCORDING TO RESIDENCE AND FAMILY TYPE

Indices of performance and variability of cane cutters, Caymanas Farm, Caymanas, Jamaica, 1950, by place of residence and family type.

	Family Type:			
	Legal Marriage	Commonlaw Marriage	Parental Family	All family types
Urban Residence:				
Performance index	132	110	92	111
Variability index	55	65	68	65
Rural Residence:				
Performance index	117	90	85	91
Variability index	75	90	90	89
All cutters:				
Performance index	125	101	87	101
Variability index	65	77	84	77
	(4)	(41)	(7)	(52)

Figures in parentheses show number of workers on whom index is based.

The workers on Caymanas farm may be divided into two groups according to their place of residence. 26 out of the 52 cutters and 16 of the 70 labourers lived in urban Spanish Town; the remainder lived in the countryside on and around Caymanas. There was a significant difference between urban and rural cutters, the urban group having a higher index of performance and lower index of variability. The same difference appeared among the labourers.

The nature of the output data collected for the cutters made it possible to attempt to assess the relative importance of the various elements of variation in the output of a given worker. There were 31 cutters who worked for the full crop period of 22 weeks. If a table is set up from the tonnages cut by each man in each week, one column being associated with each cutter and one row for each week, the vari-

ance about the general mean may be divided into three parts, one associated with the means of the columns, one with the means of the rows and the remainder with 'random' variations not governed by either of these two means. The first part of the variance can be roughly identified with the factors peculiar to the individual worker and consistent with him throughout crop. The second part can be identified with factors external to the group—mainly the scheduled output of cane from the farm for the week—and is presumed to apply to all workers in much the same degree in a given week. The third element we associate with factors peculiar to a given man in a given week, and also to errors of measurement. It was conceivable at the beginning of the study that the first element might be so small that consistent differences from man to man would be practically not worth study. In fact, however, the first two elements are of much the same magnitude measured either by the sum of squares or the mean square, and are each large compared to the third (error) element. A similar analysis of data for the preceding crop gives a similar result. This was taken as evidence that the part played by the differences in performances between workers (differences either of personality or of circumstances, but in either case consistently maintained over a period of time) are of practical importance and considerable enough to repay study of their determinants.

Earnings at Caymanas were generally higher than at Frome, in spite of very similar wage rates. This was true in 1943, when the average crop-time earnings of a cane-cutter at Frome were 13.7 shillings per week, against 25.0 shillings at Caymanas. The fact that payment per ton of cane cut was then as now at a similar rate on the two estates implies that the tonnage cut per man per week was considerably lower at Frome, or, from another point of view, that the available work was distributed over a greater number of workers. The average tonnage cut per cutter per week in 1950 was about 7 tons at Frome, against 14.5 tons at Caymanas. In 1945 the average tonnage cut per cutter per week at Caymanas had been 10 tons, and the increase between 1945 and 1950 was almost continuous. This has meant that a cane crop in 1950 which was 40 per cent greater than in 1945 was taken off by a cutting force of the same size.

Another point of difference between Frome and Caymanas appears if one examines the level of earnings and dependents. Table 29 is based on the schedules of the economic survey of conditions among sugar field workers made by the Jamaica Labour Department in 1944 (10). On both estates there is a direct relation between level of earnings in crop and the number of persons dependent on the worker, but the relation is much more marked at Caymanas than at Frome. At Caymanas workers with five or more dependents have on the average 60 per cent higher total and average weekly earnings than those with no dependents. At Frome the corresponding difference is less than 10 per cent. It is reasonable to expect that in a rural environment child-

TABLE 29. TOTAL EARNINGS AND AVERAGE WEEKLY EARNINGS IN CROP, FROME AND CAYMANAS, 1943, OF FIELD WORKERS CLASSIFIED BY NUMBER OF DEPENDENTS.

Earnings in shillings of workers with following number of dependents:				
	0	1-2	3-4	5 and over
Frome (Cutters):				
Total earnings	222	231	244	247
Average weekly earnings	13.5 (52)	13.4 (106)	14.0 (40)	13.9 (23)
Caymanas (Cutters and Labourers):				
Total earnings	250	310	330	392
Average weekly earnings	17.3 (25)	19.9 (87)	21.9 (49)	24.7 (9)

Figures in parentheses show number of workers on whom mean is based.

ren will constitute less of an economic burden than in an urban environment, and this may account for part of the difference. It may also be true that where the available work is distributed among a larger number of workers the possibility of any worker's adjusting his earnings to his individual needs is diminished. While no clear cause can be assigned for the difference, its existence seems to be reasonably well established by the above data.

Essentially this study is an attempt to explore the motivation of the Jamaican unskilled agricultural worker—not the personal day-to-day motivation of the individual but the more general impulses arising from the worker's position in certain broad social categories. The field labour force of a sugar estate is a suitable milieu for such a study since it offers large numbers of workers of differing social types, in jobs requiring the minimum of skill and equipment and paid at uniform rates. The general point that different social types differ consistently in their earnings in such a milieu can be taken as strongly supported by the results of the field work quoted in the preceding sections. An attempt is now made to interpret these results as aspects of the variations in the cash demands made on the worker by different social contexts. First, however, it is necessary to make clear the limitations of this interpretation.

One important limitation is the restricted numerical basis of the data used. Only two estates were studied, and one of these not by a strict sampling procedure; the generalisation of the results obtained to the sugar industry in general rests on the writer's judgment, and may be criticised in that light. The questionnaire method used in obtaining the basis for classification of the workers studied falls far short of the ideal, particularly in an area where the most useful lines of demarcation between different forms of such institutions as the family are not yet settled, and may appear unsatisfactory when com-

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pared with the more intensive methods of study available to the anthropologist. The most irksome limitation, however, springs from the difficulty of assigning a causal direction to the association demonstrated by the statistical analysis. At a very general level we may regard an association between a social category and a distinctive level of earnings as indicating between the two phenomena a relation of cause and effect, of effect and cause or of effects of a common cause. The interpretation given here assigns little weight to the possibility that earnings are a causal factor in assigning an individual to this or that category though it does not attempt to decide definitely between the other two possibilities. A principal reason for this choice is the fact that the earnings of a sugar field worker are largely within his own control both in the long and in the short run. In certain cases, however, earnings are in part causative—for example, in determining the transition from common-law to legal unions; but even here the possibility of a more complex relationship cannot be excluded. So far as the present section assigns a direction of causation, it must stand partly independent of the preceding sections, which were concerned with the statistical demonstration of associations.

In interpretation the factors of family situation and age must be treated together, since they form a single complex. The points demonstrated or suggested by the field work may be summarised as follows:

(a) At ages below 35 there is a considerable difference in the level of earnings of workers in different family situations; workers living with parental families have a low average, workers who are heads of married families a high average. At Caymanas the heads of legally married families have higher earnings than the heads of common-law families, while at Frome the difference is insignificant.

(b) At ages above 35 the difference between workers in different family situations is slighter than at later ages. In particular the category 'Other family situations' in the Frome data approaches the average level of earnings; this, however, is because this category at earlier ages represents workers dependent on the parental family, but at later ages the heads of 'broken' families.

(c) At ages above 50 there is a general decline in average earnings.

(d) At Frome the average earnings of workers who do not own either house or land are consistently higher than those of workers who own either of these.

(e) At Caymanas the average earnings of workers who live in the urban area are consistently higher than those of workers who live in a rural area.

(f) The average earnings of a given grade of worker at Caymanas are higher than at Frome.

This interpretation of these results rests on a rough typology of the Jamaican agricultural labourer according to the community type of which he is a member. It is a social interpretation in that it sees certain levels of earnings as the counterparts of certain social roles; but

it is not foreign to economic theory, since it is an attempt to analyse the nature of income-leisure preferences in a social context different from that in which most of the literature of labour and productivity economics has been developed. The writer believes that any attempt to increase the productivity of the Jamaican rural worker which does not take into account the intimate connection of social and economic factors in determining his earnings level will operate under a considerable and unnecessary handicap. Increased productivity means in practice increased earnings; unless the social context permits the worker to expand his demand for cash income proportionately with his opportunity for acquiring it, a change in agricultural technique or organisation will not achieve its full effect. The bearing of this on the actual situation in the Jamaican sugar industry is discussed more fully below.

We may divide the communities from which the Jamaican sugar field labourer is drawn very schematically into three main types:

- (a) rural communities so distant from the point of employment that the member who works regularly on an estate ceases to be a member of any household in his community of origin;
- (b) rural communities near enough to the estate for a member to work regularly on the estate while maintaining his membership of a household in the community;
- (c) urban communities near to the estate.

Communities of type (a) will on the whole be less dependent on the cash income from estate wage labour and more dependent on the proceeds of independent cultivation than either of the other two types.

For each of these types we can construct a roughly typical life cycle for the working class man, based on the type of household to which he belongs, his position in that household and his source of income. In the first type of community he is likely to grow up to puberty as a member of a stable household which includes his mother and father or step-father, though it may be headed by his grandmother or other relative of her generation; the economy of this household will be based on the cultivation of land owned or leased. From puberty to the age of about thirty, the worker is likely to remain a partially dependent member of the parental household; any sexual contacts he has will not lead to the setting up of an independent household, though he may undertake financial responsibility for any children he fathers. After the age of thirty he is likely to become an independent cultivator either through inheritance of part of the family property, through gift of land from his parents or through independent acquisition based on money earned by wage labour. If this wage labour is on an estate, he may leave his community for a part of the crop season and work with a high intensity in order to acquire a cash surplus to take back to his community. When he feels reasonably assured about his economic future he will perhaps take a wife, either at common-law or in legal marriage, and set up an independent stable household. His wife may have borne him children before their marriage, and will very probably bear them

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soon after, so that during the years between the ages of 30 and 50 he is the head of a dependent family. After the age of fifty one or more children will have reached working age and the household's dependence on him grows steadily less until his death.

In the second type of community certain differences will be found. The young worker is less likely to grow up in a family with a strong sense of cohesion, and his earnings during his early working life are less likely to come from land belonging to the family; in consequence the attraction of setting up early an independent household will be greater. Moreover, a higher proportion of the young working population will be migrants from other areas who will naturally set up their own households. The number of single persons living alone will therefore be greater, and so will the number of young workers with common-law wives; the setting up of a common-law household will be less the cause of separation from the parental family than the consequence of it, an arrangement of convenience, often temporary, to procure for the worker a homemaker and for the woman, some substitute for the public opinion which in the smaller rural community would ensure the worker's taking financial responsibility for any children he begot. In this second type of community the age of stable marriage remains late and it is generally true that marriage is based on a rented house and a wage income rather than, as in type (a), on an owned house and cultivation of a family plot. Where it is based on land the land is likely to be rented or leased rather than owned. Otherwise, broadly speaking, the life cycle of the worker in this type of community is similar after the age of thirty to that in type (a).

In the third type, the urban community, the differences between (a) and (b) are carried a stage further. The unstable common-law union is more common, and is entered into earlier than in communities of type (b), and the proportion of men who never enter into a stable union is greater. Rental predominates over ownership, both for houses and land, and wage income over the income from cultivation. Generally speaking, the importance of cash payment in the worker's life is much increased in comparison with type (a) communities (this is true even of sexual contacts; prostitution is an urban institution in Jamaica) and this tendency is reinforced by the greater opportunities for cash spending in urban stores and the greater need for display by each member of a temporary common-law partnership in order to retain the partner. It should be noted that the prevalence of common-law unions of the unstable type in one generation leads to the members of the next generation being brought up in households lacking one parent, usually the father, which in turn weakens the hold of the parental household on the young male and leads to his establishing a common-law household.

This typology is clearly very schematic. Its sources are, first, such literature as exists on the Jamaican family; second, the results of the Frome survey, and thirdly, a careful examination of Jamaican census

data, including some specially extracted from the schedules for this purpose.

The connection of this typology with the field work results given above may be stated as follows. The labour force of Frome belongs chiefly to types (a) and (b), with (b) preponderating; that of Caymanas (or that part studied) to types (b) and (c), with (b) preponderating. We have already said that cash payments enter into the economy of workers in urban communities to a greater extent than in other communities; this corresponds to a difference in earnings at Caymanas between urban and rural workers. Moreover since the whole rural work force of Caymanas is more 'urbanised', in a loose sense, than that of Frome, we may associate the general difference in average earnings (and output) between the two places with this factor. It should not be regarded as the only factor; in particular the labour market in the Caymanas area clearly differs markedly from that in the Frome area. There seems little evidence that the general unemployment rate is higher in Westmoreland; but the access to opportunities of high wage employment is certainly less, and underemployment probably greater.

At Frome we can roughly identify the type (a) worker with those who own house or land and the type (b) worker with those who do not. There is a marked and consistent difference between these two, which can easily be stated in terms of cash income required to maintain a given standard of total income; the possession of land greatly reduces the worker's expenditure on food, which makes up about fifty per cent of Jamaican working class budgets, and the possession of a house reduces his expenditure on rental, which accounts for another ten per cent of budgets. On the other hand, it should be noted that the type (a) worker is very well liked by the management of most estates, since, though his total earnings in a year are less than those of a similar type (b) worker, he works more intensely and with greater consistency for the period which he has set aside for this purpose, and is generally rated as honest and independent compared with the shiftless cane land worker—a characterisation which is not wholly sentimental. It does not always seem to be realised, however, that the type (a) workers represent a selected group who may be expected to show more initiative and energy than the general type (a) population.

In all types of community different types of household are associated with different degrees of responsibility of the head for the maintenance of other family members. Taking the single person living alone as the standard, the responsibility of the worker still dependent on the parental family will be low; that of the worker with a common-law wife will be higher, and that of the legally married worker higher still. The reason for legal marriage being associated with higher earnings than common-law marriage may not at first be apparent, since a stable common-law marriage is not obviously distinguishable from a legal marriage; but the Jamaican social system does impose a higher

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standard of responsibility on legal marriage, and in particular decrees that the legal wife shall not usually go out to work, whereas the common-law wife often does. In the group studied at Caymanas, for example, there were 15 cases of married couples, of which only one wife worked outside the house; there were 86 common-law couples, and 28 wives of these were gainfully occupied. Moreover, the general statement may seem to be at variance with the Frome data, which show earnings among heads of common-law households as slightly higher than among the legally married. If these are broken down into possessors and non-possessors of house or land, however, it is only among the former that the common-law average is higher, presumably because the land owned by the legally married is greater in extent, while among the non-possessors the legally married have the higher earnings. The superimposition of these family differences on a general age pattern, according to which earnings remain roughly stable from ages twenty to fifty and decline thereafter, gives us a pattern of financial responsibility which corresponds reasonably well to the pattern of earnings found at Frome and Caymanas.

There is a close correspondence between the pattern of financial responsibility which can be deduced from the nature of such institutions as the family, land ownership and community of residence as being that which affects the Jamaican sugar worker, and the actual pattern of earnings found. It would be helpful if we could extend this thesis to the more positive statement that these institutional factors are in part at least the causes of the differences in earnings, since we could then go on to argue that by manipulating the institutional factors, so far as they are susceptible of manipulation, it must be possible to change the average level of earnings within the limits of the economic situation. The nature of this more positive thesis needs careful discussion.

We may think of the relationship involved as being between three variables; a worker's earnings, his personality (including his power of choice between different social paths) and an institutional factor which prescribes for him certain social paths and certain rewards for following one of these paths rather than another. To suppose that a worker's earnings usually determine his social path seems at variance with the labour situation on the large estate, since over a period of time these earnings are not an independent variable in the sense that they are not fixed by a force outside the worker. There are a minority of cases where a worker is employed in a regular job with high earnings (e.g. some irrigation workers on Caymanas) and it is conceivable that in these cases the level of earnings determines such shifts in social situation as that from single to married status or non-possession to possession of land. But on the whole earnings are probably determined by the interaction of the worker's personality and social situation. For example, a young worker from a peasant district will probably at some time embark on the social path which leads to the acquisition of land and marriage; and his response to his decision to follow this path may

take the form of increased cash earnings, though deviations of personality will produce deviations of response. Here personality and the institutional factor must be conceived as acting jointly. When he has acquired land, however, he will be in a social position which imposes much less financial responsibility and his earnings are likely to decrease; and here the institutional factor is dominant over that of personality. It is doubtful if the partly measurable factor of social situation, and the practically immeasurable factor of personality, can be separated in their effects. Can it therefore be argued that externally induced changes in institutions will not affect the worker's economic behaviour? This is so only if one adopts the extreme position that personality (in some sense independent of the social framework) is the sole determinant of both social path and economic behaviour. This is contrary to most modern sociological writing, which sees personality and culture as continuously interpenetrating and affecting each other. The following pages, which contain some remarks on social welfare policy in the sugar industry, rest on the assumption that where changes can be made in the institutional factor by administrative action the resulting changes in economic behaviour will be considerable and predictable.

It may be asked at this point whether this analysis can serve as a guide to any aspect of labour and labour welfare policy in the sugar industry. In order to answer this question it is necessary to sketch briefly the present state of labour policy in the industry.

At the present moment labour welfare policy and general labour policy are separately formed and conducted. Welfare work in the narrower sense is carried on under the direction of a Sugar Industry Labour Welfare Board set up at the end of the war, with welfare officers in all the sugar parishes of the island. The work of these officers is carried out on what may without derogation be called 'conventional' welfare lines—the development of thrift clubs, producers' and consumers' co-operatives and youth clubs, the distribution of condensed milk and other basic foods and the establishment of recreation halls on the estates. General labour policy is controlled at the most general level by the Sugar Manufacturers' Association (who act, for example, as the employers' agent in wage negotiations) and in its details by the managements of the individual estates.

No account of the labour situation in the sugar industry would be meaningful without mention of the function of the labour unions. The field side of the industry is dominated by a single organisation, the Bustamante Industrial Trades Union, though other unions have gained local control on some estates, particularly among the skilled workers. The dominant union is of a type common in the West Indies, having the minimum of local organisation and cohering mainly through the influence of its leader, the Hon. Alexander Bustamante. The fact that Mr. Bustamante is the leader of the majority party in the Jamaican legislature introduces a complicating factor into labour negotiations in the industry. Management finds itself in the ambiguous position

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of opposing vigorously in the annual industry wide wage negotiations the man who, in his political capacity, is its strongest defender against those elements in the opposition parties that would like to apply in Jamaica either outright nationalisation or a version of the Puerto Rican '500-acre' law. The union draws much of its strength as against management from its power of hostile political action, and in turn gains political strength from its industrial representation of the field workers, among whom discontent with irregular and uncertain employment is always latent.

The sugar industry is currently faced with the problem of choice between two types of labour policy. The first type consists in adherence to the traditional employment practices associated with the use of mass seasonal and casual labour, so far, at least, as these have not been already modified by the rise of unionism. The second type would be aimed at reducing the importance of seasonal and casual workers and establishing the labour force of the estates as far as possible on a full time basis. There is no doubt that the second of these alternatives is more desirable socially and also, from the point of view of the estates' long run position, economically. It has often been advocated in the past, and was one of the principal recommendations of the 1944 Commission on the Jamaican Sugar Industry. From the point of view of the sugar employer some of the inducements to make such a change are strong. Since 1938 the industry has found itself held increasingly responsible for the welfare of its workers, by the Jamaican public and the local and metropolitan governments. In the circumstances there would be an obvious gain in having a smaller, better paid labour force concentrated in a defined area instead of having, as at Frome, a vague responsibility to persons scattered over a wide, uncertain area.

There is little reason to believe that the problem of the casual worker will eliminate itself without deliberate intervention by the management of the industry or by society. On the contrary, the number of workers who look on the estates as an occasional source of labour income is likely to grow. It is true that since 1911 the capacity of the industry to absorb labour profitably has increased, because the expansion of estate production has proceeded faster than the introduction of labour saving improvements. But the present trend is for the increase in sugar output to be based on expanded purchases of farmers' cane, and the expansion of estate cane production is slowing down—with exceptions, of course, according to the reserves of land available and the possibilities of purchasing more. The possibilities of labour saving by mechanisation have been by no means exhausted, however, even on the most modern of the estates. Hence at some time in the not distant future the labour force will cease to grow and may diminish. Meanwhile the growth of population will continue, and it remains problematical whether the island can generate or support an industrial expansion sufficient to prevent the growth of unemployment. If it does not, a part

of those who cannot find employment elsewhere will very probably swell the potential labour force of the estates; for the sugar areas are traditional centres of in-migration for the surplus rural population.

A policy of reducing the casual and seasonal nature of sugar field labour must be distinguished from a policy of mechanisation. The first does not imply any reduction in the manhour requirements of the industry, though it may be accompanied by such a reduction in certain circumstances. It does involve a reduction in the number of persons who find employment in the industry at some time during the year. A deliberate policy of mechanisation would produce a considerable fall in manhour requirements. Mechanisation is not a new thing in the history of cane cultivation in Jamaica, and in a later study an attempt will be made to trace the fall in labour requirements per unit of product which has accompanied the introduction since 1910 of the internal combustion engine into cane cultivation. Up to the present mechanical power has superseded human and animal energy chiefly in transportation and in the preparation of land. Weeding is still chiefly, and reaping wholly, a hand operation. The introduction of machines to perform these operations, and the use of chemical weedkillers, would certainly reduce the amount of labour required per unit of product considerably—perhaps by 50 per cent. The profitability of mechanisation of these operations depends on the price of labour and on the nature of the terrain. The mechanical harvesters in particular require specially favourable natural conditions to achieve satisfactory operation. Jamaican conditions are likely to delay the introduction of these particular innovations, since labour is relatively cheap and the land on which part of the cane crop is grown is uneven. They must be considered as part of the long term prospect, but the immediate future seems likely to bring merely a continuation of the present trend toward a slow decrease in labour requirements per unit of product.

The problem of irregular employment in cane cultivation has two elements which are closely connected in practice but are nevertheless distinct. The first is the problem of seasonal variation in labour demand; the second, the problem of casual employment. The demand for labour in cane cultivation varies during the year from a peak in 'crop', when the cane is harvested (roughly from January to June) to a low point in November or December. For example, on Caymanas estate in 1949 the highest point reached was in May and June, with an average weekly employment in field work of 1,700; the lowest point was in December, with 700 (Fig. 2). The crop season has fairly sharp limits and employment during the period is fairly stable in total amount, this being a condition of efficient operation of the factory. Out of crop the amount of employment fluctuates rather more, but one can reasonably speak of two distinct levels of employment, the 'crop' and 'out of crop' levels. For the whole industry in 1943 the average weekly field employment in crop was 23,300, with an average working week of

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37 hours (10). The length of the crop period varied from estate to estate between 13 and 27 weeks with an average of 18.5 weeks. For the out of crop period the average weekly employment was 14,900 with an average working week of 34 hours. The average weekly manhour requirements out of crop are therefore about 60 per cent of those in crop. There is also probably some difference in intensity of work between the crop and out of crop periods.

The possible methods of reducing the difference in demand for labour between the two periods do not appear to hold any promise of equalising employment completely over the year. One approach is through an extension of the cutting season. Such extension is limited in Jamaica by climatic factors, though the possibilities are greater on irrigated estates than on those depending on natural rainfall. Caymanas estate has begun to conduct experiments with this in view. Another approach is through the cultivation of a non-seasonal crop along with cane, such as bananas and citrus, as is done on several estates (e.g. Caymanas, Monymusk). While this tends to reduce the relative fluctuation of the estate's total field labour requirements, it does not greatly affect the absolute difference between labour requirements in and out of crop. The problem is intensified by the fact that mechanisation is being applied more successfully at present to the operations characteristic of the out of crop period, while the prospects of applying mechanical methods to cane cutting, which accounts for a large part of the excess of the labour demand in crop over that out of crop, are at present slight.

If the labour force of the estates is to be stabilised, in the sense that the number of persons in the employment of the estates is to be kept fairly constant over the year, the size of the labour force will be determined by the number of workers required to fulfil the demands made by crop-time production. In the out of crop period the available workers will exceed the available jobs by a factor of 60 or 70 per cent on the present distribution of labour requirements between crop and out of crop. Some way must be found of ensuring that the workers for whom work is not available at any particular date in the out of crop period remain part of the estate's labour force and receive some income either at that time or within a predictable period. There are at least three conceivable ways of securing this result. One is the payment of a small weekly wage to workers who are not actually in work, of an amount less than they would normally earn when in work, to secure their continued attachment to the estate. Another way is to rotate the available work among the labour force so that they would be assured of a certain proportion of weeks in work. Not all jobs would be rotatable, so that the proportion of idle time to working time for those affected would be higher than if the work were spread evenly over the labour force. A third way would be by the shortening of the working week, which would be equivalent under the conditions of

sugar field labour to the distributing of smaller tasks to a larger number of men. Some loosely organised form of either rotation of work or the shortening of the week—which are both forms of work-spreading—is practised already on many estates.

All these procedures have serious drawbacks. If a guaranteed wage is paid, there will certainly be some workers whose demand for income is met by the small sum received when not working, and these will have a strong motive for evading work though remaining on the list of estate employees. The cost of a guaranteed wage scheme to the estate might for this and other reasons be considerable. A rotation scheme might encounter difficulties if the amount earned under it was not sufficient to induce the worker to hold himself available for estate work, so that he took another job in preference to holding himself bound to work for the estate when called on to do so. The same thing applies to the reduction of weekly tasks; and it is true of both these methods, also, that they make the organisation of the work more difficult and so entail an indirect cost. The difficulties will be disproportionately greater, the greater the gap between average weekly employment in and out of crop. The chances of success of any scheme along these lines will be improved if the average weekly employment in crop can be reduced.

Mechanisation is an obvious way of reducing manhour requirements in crop, but to be economic would need to be applied also out of crop, and so would not reduce the seasonal fluctuation. The problem might be met by an intensification of effort in crop with existing techniques, leading to increased output per worker. There is no physical reason why such an increase in output should not be achieved. In any group of Jamaican sugar field workers there is a wide variation in output per week, the greater part of which cannot be attributed to variations in physique or health. There is also a wide variation in the average level of output on similar operations from one estate to another. As an example we may take the group of cane cutters cited in (10), p. 90. In the survey week the average tonnage of cane cut by the group of 42 cutters was 11.7 tons. The average of the ten highest outputs, however, was 18.5 tons. Had the average output of the whole group been the same as that of the upper quartile, the same total tonnage would have been cut by 28 cutters, or a third less than were actually employed. The average weight of cane cut per hour was one third of a ton. If the gang had consisted entirely of cutters with the same output per hour as the upper quartile, and working for a 45-hour week, the same total tonnage would have been reaped by 24 cutters, or 43 per cent less than the actual figure. It may be objected that the upper quartile represents a superior group and that their output may be beyond the physical capacity of the remainder of the gang. While it is true that in certain cases output may be kept low by physical causes, the levels of output of the upper quartile cited here are much

lower than those achieved on some Jamaican estates and are certainly not physically impossible of achievement by the average worker.

If an increase in the intensity of work in crop, to a point where the weekly labour requirements can be met by a number of workers not greatly in excess of those now employed out of crop, is physically possible, the process of transition from the present state to a system of full-time employment does not present the same insuperable difficulties as at first sight. One of the principal problems in arranging such a transition would be that of securing a labour force whose incentive was sufficient to induce them to work at the higher intensity in crop. The relevance of the present study to this point is considered below.

The problem of the seasonal variation in the estates' labour requirement is complicated by a second feature of the present labour system, namely its employment of casual labour. The problems of casual labour and of seasonal labour are not identical. The essence of a casual labour system is that a worker's chances of securing employment with a given employer for some short time period, such as a week, are independent of his having been employed in a previous period. Such a system is likely to create greater social problems in an industry where the demand for labour fluctuates seasonally or irregularly, so that lay-offs and rehiring are frequent. The employer is in fact unlikely to ignore the fact that certain of the workers who offer themselves for employment have been previously employed by him and have gained experience of the working methods used in his establishments, and a casual employment system is likely to affect different workers unequally, some becoming members of a nuclear group which secures relatively steady employment while others obtain work with varying degrees of irregularity. Some writers on the problem tend to adopt the position that the system of casual labour is essentially exploitative and that its abolition represents an unqualified social gain. It must be remembered, however, that a modern industrial system has little place outside casual labour occupations for the man whose demand for income is low and whose valuation of leisure is high—a set of preferences which if often irrational is no more so than many which are given social recognition. If one is trying to reduce the casual element in an employment situation, it is necessary to remember that there are likely to be some workers who will not welcome full-time work and that if the success of the new system of employment is made dependent on the co-operation of these workers, it will operate under a handicap. Specifically, if the level of employment in a given period is so fixed that the work available will be performed if all workers work a full week, and if the income available from a full week's work is greater than some workers would achieve under a casual system and the working period is longer, there is a strong likelihood that some workers will not work their full week and available work will not be fully performed. Where full-time regular employment is substituted for casual labour, some

place must be left for the worker with a low income demand or any other form of temperamental bias toward casual labour, and this will be particularly true in the early stages.

The basis of casual labour in the sugar industry in Jamaica is the fact that most unskilled operations are paid on a 'task' basis. At the beginning of the working week each worker employed is assigned a 'task'—for example, the weeding of so many chains of canes—which is paid on a piece basis. This task usually has a rough correspondence with the average achievement in a day or a week, but may vary considerably according to the capacity or desire of the worker, the amount of work available, the number presenting themselves for employment and chance factors. 'Task' work has some analogy with piece work, in that the payment received is directly proportional to the work done. But the legal and customary position of the task worker vis-a-vis his employer is that of the tradesman, for example, hired to do a given 'job', in that when the task is finished the employer is under no obligation to provide further work or to give notice of dismissal.

The task system is so deeply rooted in the Jamaican sugar industry that it would have to be envisaged as continuing under a non-casual employment system. The problem therefore presents similarities with such forms of casual 'job' labour as were formerly found in English port transport, and the most feasible way of tackling it might be by a scheme of registration similar to that now applied to English port workers. A feature of this scheme is that it operates in two stages; the first is registration and the exclusion of non-registered workers from the industry, the second is a reduction in the labour force of the industry by the restriction of new entries to a level where they do not replace wastage. An important consideration in applying such a scheme to Jamaican sugar labour would be the fact that it is easier to carry out in an industry whose total demand for labour is expanding than in one whose demand is stable or contracting. The market prospects of the sugar industry are therefore very relevant to its labour policy.

It must be made clear that the object of this paper is not to argue for or against the elimination of casual labour in the sugar industry. The aim is rather to make clear the nature of the change and to show that it has been seriously canvassed and is a possible aim of labour policy. There are strong forces operating against the change and particularly against the public discussion of it. One of the traditional functions of the estate has been that of maintaining a certain minimum level of welfare in the area from which its labour force has been drawn. An estate like Frome or Monymusk has many of the responsibilities of a local government authority; it not only provides electricity, water and roads for a considerable area, but also finds its labour policy necessarily affected by the need to keep the number of absolutely unemployed in the district to a minimum, from motives of charity and of political

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expediency. A change in labour policy which deprived or casual employment a part of the present labour force would have considerable repercussions. Even where wages form a small proportion of the worker's income, they may be a much larger proportion of his income in cash, and a certain amount of his expenditure must be made in this form. The opposition of the large number of casual employees to a change which would disturb their pattern of income and in some cases diminish their total income might seriously inconvenience the industry, particularly in view of the close connection between politics and unionism in the island as a whole. The case for or against the elimination of casual labour is therefore by no means closed.

It has been argued above that the elimination of a seasonal difference in numbers employed would be facilitated if incentives could be increased so as to raise the intensity of work in the crop season. A somewhat similar argument applies to the reduction of the casual element in employment in the sugar industry. A probable form for such a reduction to take would be the employment of registered workers only. This, however, would have little beneficial effect on the workers unless it led to a reduction in the number registered, either absolutely or in relation to the labour requirements of the industry. Such a reduction in numbers employed is only feasible if the average level of output (and, it may be assumed, of earnings) is raised. It cannot safely be assumed that simply making available more work per person employed will ensure, of itself, that the average output will increase sufficiently to supply the labour demands of the estate. Many workers, if given the opportunity of increasing their earnings by increasing their output, will do so. Some, however, will certainly fail to complete their tasks or will not present themselves for work regularly. This will mean organisational difficulties which may be more or less serious, according to the completeness of the response to the increased earnings opportunities. If the failure to respond is general enough the system may even break down.

The fact that registration of workers permits a certain degree of selection in the recruitment of new workers may offer a way of ensuring that the incentive of the average worker to increase his output in response to the opportunities offered by a non-casual system of employment is strong enough to make the system workable. The field results have suggested that workers of different social categories differ systematically in their demand for income. Selection in favour of those categories whose demand for income is high would tend to raise the average demand for income in the labour force. Not all the categories used in the field work would be suitable bases for selective recruitment. It would perhaps be impracticable to show preference for the married man against the single, or for the older single man against the younger. The division of workers according to community type and possession or non-possession of land might, however, find indirect application.

A full-time system of employment would in any case favour the man who did not possess land, since for the worker who is also a cultivator full-time work would present difficulties in the way of spending time on his own land at the most convenient periods. A policy of offering registration to workers living near the estate or more particularly in one or a small number of communities standing in a close relation to the estate, would also indirectly favour the worker who does not possess land, since the proportion of workers in estate villages who do not own land is on our field results higher than in the labour force as a whole. Further, if the field results can be interpreted as indicating that urbanisation is a factor in providing incentive to increase one's cash income, it is the villages rather than the peasant areas which will offer most prospect for the development of urban attitudes. This will apply more strongly where an estate draws its labour force from a town, and selection can be made in favour of urban workers.

This argument has an application to welfare policy in the narrower sense. There has, up to the present, been a natural tendency to concentrate the sugar industry's welfare facilities within the estate boundaries. In many cases the communities to which the workers belong are located off the estate, and so far as welfare work is successful it tends to weaken the influence of the community of residence on the worker. An alternative type of policy might be preferable which would concentrate the location of welfare facilities such as community halls and co-operatives in the worker's own community and would favour by any available means the development of this community toward a point where it could afford the worker opportunities of cash expenditure comparable to those of a fully urban environment. Such a policy would be particularly applicable if a full-time labour force were to be established, since such a change would probably lead to a considerable growth in the communities on the borders of the estates in order to accommodate the increased number of workers fully dependent on the sugar industry.

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## APPENDIX

This appendix gives in summary form the composition according to birthplace and years of residence in the parish of the census population of St. Catherine, 1943; of the sugar labour force of the Caymanas-Spanish Town area; and of the labour force of Caymanas estate; also the composition according to conjugal condition and age of the sugar labour force of the Caymanas-Spanish Town area and of the labour force of Caymanas Farms. The bold figures are percentages.

## POPULATION OF ST. CATHERINE PARISH, CLASSIFIED BY BIRTHPLACE AND YEARS OF RESIDENCE IN ST. CATHERINE.

Females	Birthplace;				
	St. Catherine	Clarendon, Manchester, St. Elizabeth, Westmoreland	St. Mary, St. Thomas, Portland	Other	Total
Years of residence;					
Less than 2		756	516	733	2005
		38	26	37	100
2 - 4		1050	661	831	2542
		41	26	33	100
5 - 9		896	398	657	1951
		46	20	34	100
10 - 14		695	393	347	1435
		48	27	24	100
15 - 19		503	140	297	940
		54	15	32	100
20 and over		1284	350	759	2393
		54	15	32	100
Born in St. Catherine	49088				49088
	49088	5184	2458	3624	60354
Total	81	9	4	6	100

Males	Birthplace;				
	St. Catherine	Clarendon, Manchester, St. Elizabeth, Westmoreland	St. Mary, St. Thomas, Portland	Other	Total
Years of residence;					
Less than 2		561	440	673	1674
		34	26	40	100
2 - 4		1010	615	280	2505
		40	25	35	100
5 - 9		964	413	641	2018
		48	20	32	100
10 - 14		819	301	496	1616
		51	19	31	100
15 - 19		498	130	285	913
		55	14	31	100
20 and over		1456	330	745	2531
		58	13	29	100
Born in St. Catherine	47307				47307
	47307	5308	2229	3720	58564
Total	81	9	4	6	100

SUGAR WORKERS, SPANISH TOWN-CAYMANAS AREA, CLASSIFIED BY  
BIRTHPLACE AND YEARS OF RESIDENCE IN ST. CATHERINE PARISH

Females	Birthplace;				
	St. Catherine	Clarendon, Manchester, St. Elizabeth, Westmore- land	St. Mary, St. Thomas, Portland	Other	Total
Year of residence;					
Less than 1		1 14	3 43	3 43	7 100
2 - 4		10 50	3 15	7 35	20 100
5 - 9		20 65	7 22	4 13	31 100
10 - 14		25 66	5 13	8 21	38 100
15 - 19		17 71	0 0	7 29	24 100
20 and over		38 68	4 7	14 25	56 100
Born in St. Catherine	159				159
Total	159 47	111 33	22 7	43 13	335 100

Males					
Years of residence;					
Less than 2		27 47	16 28	15 26	58 100
2 - 4		53 43	32 26	38 31	123 100
5 - 9		62 54	21 18	32 28	115 100
10 - 14		52 60	12 14	23 26	87 100
15 - 19		25 53	6 13	16 34	47 100
20 and over		77 66	2 2	35 31	114 100
Born in St. Catherine	337				337
Total	337 38	296 34	89 10	159 18	881 100

## LABOURERS AND WEEDERS, CAYMANAS FARM, BY PARISH OF BIRTH

Birthplace:	St. Catherine	Clarendon, Manchester, St. Elizabeth, Westmoreland	St. Mary St. Thomas, Portland	Other
Labourers:				
Grass Billing	9	11	4	3
Cleaning				
Trenches	7	13	4	2
Irrigation	10	1	5	1
All Labourers	26 37	25 36	13 19	6 9
Weeders	19 47	13 32	5 12	3 7

## SUGAR WORKERS, SPANISH TOWN-CAYMANAS AREA CLASSIFIED BY CONJUGAL CONDITION AND AGE GROUPS

Females	Single & Widowed	Common-law Marriage	Legal Marriage	Total
Age:				
Under 30	67 60	43 38	2 2	112 100
30 - 39	65 59	37 34	8 7	110 100
40 - 49	34 52	22 34	9 14	65 100
50 and over	34 71	9 19	5 10	48 100
All ages	200 60	111 33	24 7	335 100
Males				
Under 30	220 68	90 28	12 4	322 100
30 - 39	110 42	124 47	28 11	262 100
40 - 49	67 33	93 48	38 19	203 100
50 and over	47 50	29 32	18 19	94 100
All ages	444 50	341 39	96 11	881 100

SUGAR WORKERS, CAYMANAS FARM, CLASSIFIED BY CONJUGAL  
CONDITION AND AGE GROUPS

Females	Single & Widowed	Common-law Marriage	Legal Marriage	Total
Age:				
Under 30	5 62	2 25	1 12	8 100
30 - 39	6 60	4 40	0 0	10 100
40 - 49	6 46	6 46	1 8	13 100
50 and over	7 78	1 11	1 11	9 100
All ages	24 60	13 32	3 8	40 100
Males				
Under 30	9 32	18 64	1 4	28 100
30 - 39	7 21	24 71	3 9	34 100
40 - 49	4 15	17 65	5 19	26 100
50 and over	3 16	12 63	4 21	19 100
All ages	23 21	71 66	13 12	107 100

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## SEASONAL VARIATION AND EMPLOYMENT IN JAMAICA

BY

H. D. HUGGINS

### INTRODUCTION

This paper should be read as part or continuation of a study on economic development in Jamaica which appeared previously (2). It attempts to examine aspects of seasonal variation in special relation to some of the implications for employment.

A first and introductory section has information on secular trends in Jamaica's recent past. The body of the paper deals with the calculations of and conclusions from indices of seasonal variation computed in a number of instances; whenever possible the link relative method of computation is used. The last part of the paper discusses approaches to the problem which one may consider.

### SOME BACKGROUND TRENDS

Juglar did much to give a specific conception to the idea of secular movements which his predecessors had thought of and written of. Jevons, while not claiming credit for the concept, did much of the early statistical work in measuring seasonal variation. Because of the dominating influence of long-term trends there has been, relatively, less attention paid to the lesser disturbances, seasonal variation. In the present paper the chief concern is with seasonal change but a limited amount of available data on some long-term trends in Jamaica can be useful as background material.

The economy in Jamaica is essentially agricultural. A part of the island's production consists of food crops, essentially for internal consumption and it was only when national income estimates were prepared that there was general appreciation of how important, relatively, were these crops. The 1943 estimates indicate that root crops made up some 22 per cent of total primary and secondary agricultural production. Nevertheless, one is unable to include these crops in the discussion of long-term trends because basic figures are unavailable. The only products for which figures are recorded over a long period are those entering into the export trade (Table 1) and the statistics, as inadequate as they are, make it possible to consider the secular trends of some of the major products in the Jamaica economy. A convenient starting point for these trends is the period around the Great Depression, 1873. One good reason for this is that the depression led to the appointment of the 1882 and 1897 Royal Commissions and these in turn resulted in the careful tabulation and recording, in easily available form, of contemporary statistical data.

TABLE 1. PHYSICAL VOLUME OF EXPORTS, JAMAICA (1939 = 100)

Year	Weighted aggregative physical volume indices										
	Bananas	Cocoa and Cocoa Products	Coconuts and Coconut Products	Coffee	Ginger	Citrus and Citrus Products	Pimento and Pimento Products	Sugar	Tobacco (Cigars)	Logwood and Logwood Extracts	Rum
1880	2.4	7.1	16.7	122.0	—	18.1	121.8	26.2	33.3	112.5	199.4
1882	4.7	3.1	7.5	83.8	20.0	39.5	101.5	33.7	63.3	74.3	271.1
1884	9.8	8.7	14.8	64.8	40.9	45.5	147.5	28.2	16.7	109.1	242.7
1886	8.6	8.3	10.1	73.6	38.9	44.7	82.5	15.8	16.7	154.2	176.0
1888	16.5	10.3	16.1	132.7	34.5	52.0	88.9	23.5	23.3	244.9	222.7
1890		3.5		98.4	16.7		47.7	8.2	13.3		69.6
1892	18.7	11.8	21.4	116.6	54.9	25.1	85.1	20.4	63.3	210.4	203.2
1894	24.9	20.2	27.7	127.6	50.3	35.6	112.1	19.1	56.7	185.3	233.2
1896	25.8	19.8	32.2	89.3	59.0	117.0	132.9	15.4	66.7	162.4	195.9
1898	39.9	45.4	32.6	147.9	51.2	116.0	104.0	17.3	103.3	166.7	186.4
1900	43.9	50.7	37.0	115.2	89.4	98.1	134.2	14.2	150.0	260.5	167.4
1902	58.6	68.2	69.9	144.6	98.2	109.0	153.5	19.5	140.0	162.2	229.7
1904	41.6	70.2	11.6	69.2	74.2	81.2	206.0	9.5	116.7	170.4	147.1
1906	79.8	102.8	30.2	73.6	60.7	65.4	113.9	13.4	153.3	187.2	174.4
1908	74.3	106.2	30.4	94.4	69.8	46.5	292.9	5.9	210.0	206.8	148.4
1910	75.1	75.6	49.5	117.1	79.8	63.4	147.5	19.2	223.3	284.6	160.6
1912	71.3	141.9	62.8	120.1	83.6	42.7	143.5	9.5	223.3	344.8	106.7
1914	86.3	156.2	80.4	107.0	64.9	25.4	115.2	14.8	286.7	384.5	132.7
1916	18.6	139.0	80.3	88.4	57.4	23.4	85.1	27.2	353.3	470.8	214.3
1918	17.1	128.1	54.6	122.6	91.1	19.2	76.4	25.6	613.3	272.2	22.8
1920	48.1	109.0	84.8	55.3	49.6	20.6	90.2	35.2	556.6	356.1	88.6
1922	67.7	166.0	96.6	84.8	44.8	19.3	137.1	48.6	310.0	268.6	96.4
1924	63.8	127.9	78.8	69.6	52.2	23.0	108.2	22.0	293.3	229.4	87.0
1926	97.5	130.0	114.5	89.1	92.3	36.2	103.2	46.2	253.3	146.9	82.6
1928	91.0	97.3	125.7	105.7	71.3	45.6	109.5	46.8	203.3	158.6	96.3
1930	131.0	130.9	139.4	82.3	74.8	31.2	115.9	48.4	230.0	102.0	80.9
1932	108.4	94.5	141.5	106.3	50.0	51.7	100.3	36.9	160.0	103.6	21.6
1934	85.1	85.6	101.3	85.4	72.1	48.5	148.5	52.1	116.7	109.3	54.8
1936	99.9	70.2	85.9	124.5	102.9	103.8	72.7	74.7	120.0	110.3	80.8
1938	126.8	101.9	97.1	113.3	88.2	94.5	106.9	100.8	106.7	67.4	107.3
1939	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1940	36.5	39.3	47.8	70.2	77.4	73.0	45.0	78.0	133.3	98.5	127.1
1941	29.8	97.4	47.7	60.0	71.5	47.7	44.7	131.9	240.0	71.6	52.7
1942	71.7	88.8	45.5	63.5	55.5	69.1	51.2	123.2	376.6	91.7	49.5
1943	1.5	91.6	94.3	50.2	75.8	55.7	64.6	134.9	523.3	112.2	49.2
1944	5.9	87.0	56.6	57.4	97.8	65.3	38.7	126.7	516.6	27.5	67.0
1945	9.6	38.4	—	67.2	98.0	40.8	70.0	113.6	753.3	67.9	98.8
1946	31.0	61.2	—	26.7	117.0	75.7	57.2	142.7	1,216.5	52.3	201.9
1947	29.4	67.1	—	42.3	103.5	68.1	35.6	122.8	2,319.8	138.9	274.9
1948	32.5	82.0	0.1	36.9	94.0	136.8	62.6	144.8	806.6	79.2	222.9
1949	35.0	80.8	—	28.8	64.4	167.0	104.4	185.3	669.9	41.3	195.6
1950	30.7	95.5	0.3	35.6	77.9	124.3	60.1	213.2	799.9	117.3	281.7
1951	19.7	75.1	0.2	30.0	89.9	91.5	95.2	204.2	776.6	109.9	253.4
1952	24.3	114.7	0.1	29.8	91.6	89.7	65.4	191.4	909.9	65.3	196.9

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TABLE 2. COMPOSITION OF JAMAICA'S DOMESTIC EXPORTS

Year	Percentage value of Jamaica's domestic exports contributed by													
Rum	Bananas	Cocoa and Cocoa Products	Coconuts	Coffee	Ginger	Citrus and Citrus Products	Pimento	Rum	Sugar	Tobacco (Cigars)	Logwood and Logwood Extracts	Coconuts and Coconut Products	Pimento and Pimento Products	
199.4	1866	0.0	0.0	0.3	16.4	2.5	0.1	3.0	20.4	48.4	0.0	5.2	0.3	3.0
271.1	1868	0.0	0.1	0.2	14.8	2.9	0.1	2.6	18.1	48.4	0.1	7.4	0.2	2.6
242.7	1870	0.1	0.2	0.4	19.2	0.6	0.2	2.5	20.3	42.4	0.0	12.2	0.4	2.5
176.0	1872	0.2	0.2	0.2	17.9	0.8	0.3	1.6	19.9	40.7	0.0	11.5	0.2	1.6
222.7	1874	0.4	0.1	0.4	15.5	1.9	0.7	2.9	22.7	32.2	0.0	10.8	0.4	2.9
69.6	1876	0.8	0.1	0.5	18.6	1.4	0.8	4.7	21.2	36.4	0.0	20.7	0.5	4.7
203.2	1878	2.4	0.5	1.0	18.4	1.3	1.0	5.8	14.5	30.6	0.0	8.7	1.0	5.8
232.2	1880	1.9	0.2	0.8	11.2	1.3	1.0	7.5	14.8	28.6	1.2	11.2	0.8	7.5
195.9	1882	6.0	0.2	0.7	9.1	0.8	2.6	7.7	20.1	41.7	0.7	6.3	0.7	7.7
186.4	1884	14.2	0.7	1.6	7.3	1.6	4.5	6.9	16.3	31.7	0.2	10.0	1.6	6.9
167.4	1886	15.4	0.9	1.1	11.1	2.0	5.4	4.4	17.1	18.8	0.2	17.7	1.1	4.4
229.7	1888	16.3	0.6	1.3	19.4	1.1	4.1	2.7	12.2	17.4	0.2	21.2	1.3	2.7
147.1	1890	24.6	0.4	1.6	15.7	1.3	2.7	1.7	7.2	5.7	0.3	21.1	1.6	1.7
174.4	1892	20.1	0.7	1.4	20.2	1.6	1.7	3.5	15.1	15.1	0.3	19.9	1.4	3.5
148.4	1894	23.5	1.1	2.0	19.5	2.5	2.9	4.6	10.3	13.1	0.4	18.8	2.0	4.6
160.6	1896	20.5	0.9	2.1	19.3	3.4	10.1	5.2	7.2	7.1	0.5	11.1	2.1	5.2
106.7	1898	30.6	3.5	2.2	10.6	2.8	8.8	8.4	6.8	9.8	0.9	8.6	2.2	8.4
132.7	1900	35.6	3.7	2.4	9.0	3.8	7.4	6.4	8.8	9.5	0.9	7.5	2.4	6.4
214.3	1902	15.1	2.9	3.1	5.9	2.1	5.1	4.1	7.1	7.6	0.8	5.9	3.1	4.1
22.8	1904	38.5	3.1	1.3	6.4	2.0	5.4	10.3	6.9	8.7	1.4	10.4	1.3	10.3
88.6	1906	46.8	5.8	2.2	4.7	2.1	4.7	4.2	7.1	6.3	1.3	8.4	2.4	4.2
96.4	1908	50.1	4.4	2.2	5.6	2.1	2.7	6.9	8.95	3.7	1.4	7.7	2.1	6.9
87.0	1910	47.3	2.6	3.3	6.9	1.9	3.4	3.1	5.6	10.8	1.4	9.5	3.3	3.1
82.6	1912	48.3	5.4	4.2	10.7	1.9	2.3	3.0	2.6	5.2	1.4	9.7	4.2	3.0
96.3	1914	53.2	5.5	4.4	5.9	1.1	1.5	1.6	3.6	7.0	1.3	10.3	4.5	1.6
80.9	1916	8.0	6.0	6.5	5.2	1.9	1.4	1.6	12.7	18.2	1.8	28.9	6.9	1.6
21.6	1918	11.7	6.1	4.4	8.5	3.3	1.6	2.6	1.6	24.1	3.8	15.9	6.0	2.6
54.8	1920	19.7	3.2	4.9	2.7	1.4	0.9	1.6	4.3	44.6	1.8	10.0	5.1	1.6
80.8	1922	43.9	0.3	3.4	5.0	2.2	1.3	1.5	2.0	22.4	1.5	8.3	3.8	1.5
107.3	1924	39.6	2.7	4.3	7.3	3.0	2.1	2.6	3.9	16.1	1.8	8.8	5.7	2.6
100.0	1926	49.4	2.9	2.5	6.9	1.7	2.3	4.5	2.1	15.6	1.1	4.3	4.8	4.5
127.1	1928	42.8	2.7	3.8	9.1	2.0	3.1	6.8	1.9	17.1	1.1	4.2	5.6	6.9
52.7	1930	57.2	2.0	2.9	4.0	1.2	2.2	4.8	2.2	14.7	1.1	2.9	4.7	4.8
49.5	1932	59.6	1.5	4.2	7.1	1.1	4.3	2.0	0.7	10.9	0.9	3.6	5.3	2.0
49.2	1934	54.0	1.4	3.2	5.5	2.1	4.0	3.2	4.4	14.7	0.6	3.6	3.2	3.2
67.0	1936	51.7	1.3	2.1	4.4	2.0	5.9	3.8	5.3	17.1	0.5	2.9	2.1	3.9
98.8	1938	59.2	1.0	1.7	2.7	1.0	3.3	4.2	5.0	17.4	0.3	1.3	1.9	4.3
201.9	1939	52.5	1.0	1.6	3.1	0.9	4.3	4.5	5.3	21.3	0.4	2.0	1.9	4.6
274.9	1940	34.2	0.9	1.2	3.7	1.5	5.4	3.9	11.1	27.8	0.7	3.2	1.6	4.2
222.9	1941	23.7	2.4	1.4	2.9	1.9	4.6	4.0	7.0	41.7	1.2	1.6	1.6	4.4
195.6	1942	7.1	2.7	2.4	3.6	3.2	4.6	5.5	9.8	42.0	2.4	2.2	3.1	6.0
281.7	1943	1.2	2.7	4.4	2.8	3.1	9.1	5.9	11.4	45.3	3.0	2.4	6.2	6.5
253.4	1944	4.6	2.4	3.4	4.5	3.7	9.1	3.2	13.9	42.8	3.6	0.7	3.4	3.5
196.9	1945	7.5	0.9	0.0	5.0	3.2	7.1	4.9	16.3	40.5	6.4	1.7	—	5.5
	1946	19.0	0.8	0.0	1.2	1.9	3.7	2.2	19.7	32.2	6.4	1.4	—	2.5
	1947	20.6	1.4	0.0	1.6	1.2	3.2	1.6	25.9	26.7	9.1	1.9	—	1.7
	1948	20.8	3.2	0.0	1.3	1.1	7.3	2.0	18.3	32.1	4.5	1.1	2.8	2.1
	1949	19.2	1.8	0.0	1.1	1.1	8.8	3.4	10.9	39.7	3.3	0.6	0.1	3.5
	1950	14.4	2.8	0.0	2.3	2.4	7.4	2.0	10.9	52.3	3.9	1.3	2.2	2.1
	1951	7.7	2.9	0.0	2.2	3.0	6.3	3.6	9.8	38.5	3.9	1.1	1.1	3.8
	1952	10.9	4.4	0.0	2.1	1.5	6.6	2.4	7.1	43.6	3.4	0.6	0.5	2.7

*Weighted aggregative physical volume index.*

In order to present the data in comparable terms a weighted aggregative physical volume index was computed. For commodities composed of one homogeneous item the volume index was calculated as the simple percentage in quantity terms of the base year level. In those cases where the commodity group is composed of a number of items a base weighted volume (or 'quantum') index of the form

$$Q_{ns} = \frac{\sum p_o q_n}{\sum p_o q_o}$$

was constructed (Table 1).

In a few instances certain constituent items of the commodity group were not exported in 1939 although they became important in post-war years. This was the case with cocoa (raw and products) and citrus (fruit and products) and, to meet the situation, a current weighted price index was first calculated of the type

$$P_{ns} = \frac{\sum p_n q_n}{\sum p_o q_n}$$

for an appropriate selection of items which gave a minimum coverage of 70% of the group for all years. The volume index was then derived by applying this price index to the total value for the commodity group. In this way one expresses the value of the physical volume of exports each year at 1939 prices. The value thus obtained is converted into a percentage of the 1939 value of exports, i.e., into a weighted aggregative physical volume index.

On the basis of 1939 the physical volume of exports of bananas began to rise steeply by the late 1880's and had an index, by the early 1890's, of over 20 (1939=100), approaching 80 by the early years of the century and was 86 when the first world war broke out. As in the second world war, because of shortage of shipping space, exports almost ceased. By this time Panama Disease had appeared but had no significant effect on total exports. After the war the quantity of banana exports quickly regained the pre-war position and by 1926 was 98. The upward trend continued and reached its peak in 1937. The physical volume index shows a steady decline since. The disruption of shipping in the war years and, more important, the effects of disease and erosion led to a reduction of the volume of exports in the 1950's to a lower level than at any time since the 1890's, war and immediate post-war years alone excepted.

The physical volume index shows how different from bananas has been sugar's history. Wars disrupt the banana industry but have no such effect on sugar. On the contrary, sugar's exports, while fluctuating around an index of about 12 in the years preceding the first world war were nearly 30 by 1916 and nearly 50 by 1922. The index fluctuated

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TABLE 3. INDEX NUMBER OF F. O. B. PRICES (1939 = 100)

Year	Indices of f. o. b. prices of										
	Bananas	Cocoa	Coconuts	Coffee	Ginger	Oranges	Pimento	Rum	Sugar	Tobacco (Cigars)	Logwood
1906	43	221	168	82	161	84	32	31	89	98	107
1907	42	306	174	76	219	64	33	45	108	99	105
1908	57	177	168	84	156	58	23	51	131	87	94
1909	55	178	172	88	129	52	25	48	126	81	90
1910	62	171	182	98	140	60	23	34	137	89	97
1911	68	181	202	131	143	60	25	25	129	98	107
1912	71	204	198	156	142	67	25	25	141	96	99
1913	66	237	239	139	126	80	22	35	112	88	93
1914	71	202	177	106	115	65	18	31	134	80	97
1915	57	285	157	104	164	64	18	48	177	77	159
1916	49	249	276	112	229	64	24	66	186	83	239
1917	73	189	266	116	245	69	31	45	231	77	171
1918	72	249	329	121	230	92	41	73	241	96	158
1919	91	391	492	247	259	151	55	101	367	85	224
1920	139	402	486	225	468	124	54	131	851	132	362
1921	119	143	252	128	372	106	19	68	199	126	272
1922	125	172	193	165	498	141	21	34	189	116	186
1923	140	133	227	160	476	116	21	32	275	115	161
1924	79	143	256	221	443	136	34	55	228	113	140
1925	77	174	245	238	236	141	57	70	151	114	157
1926	87	194	188	223	191	116	84	42	143	112	152
1927	86	295	210	200	177	100	104	34	167	123	148
1928	80	233	215	245	290	113	127	32	153	135	133
1929	88	185	201	230	230	124	150	34	136	130	152
1930	72	129	160	134	162	133	78	45	123	117	128
1931	68	92	144	106	113	141	34	34	90	99	112
1932	71	105	140	144	176	138	29	39	93	113	126
1933	74	93	132	127	153	140	30	42	98	105	120
1934	80	103	109	135	221	116	31	100	87	95	117
1935	82	106	102	117	199	112	39	108	85	103	117
1936	78	146	102	89	174	98	93	97	85	94	107
1937	76	181	117	110	192	91	98	99	95	100	107
1938	94	95	105	80	142	84	93	93	86	95	108
1939	100	100	100	100	100	100	100	100	100	100	100
1940	117	139	115	111	149	108	132	107	109	105	103
1941	124	198	126	139	251	116	181	203	121	117	105
1942	156	242	236	150	556	146	207	308	132	152	125
1943	126	242	276	154	405	128	181	379	137	140	—
1944	137	242	302	234	401	196	182	363	148	183	180
1945	154	225		242	381	259	171	318	172	248	215
1946	216	235		273	337	248	181	338	195	273	188
1947	286	429		251	285	267	182	376	211	236	221
1948	293	892		269	327	271	179	369	249	378	271
1949	266	530		311	499	264	186	266	256	350	368
1950	282	900		656	1,079	309	255	237	280	427	230
1951	264	1,213		820	1,365	381	318	477	320	492	292
1952	319	1,375		816	706	405	361	251	370	388	254

about this level and again began to rise as the second world war approached, had reached 100 by 1938, 135 by 1943, 143 by 1946 and 204 by 1951. Sugar's physical volume index was in the 1950's more than twice as high as that in 1939, more than four times that in 1930, nearly six times that in 1920; rum, a byproduct of sugar, has shown the same general trends.

The volume of exports of cocoa and cocoa products began to rise from the beginning of this century and began to decline from about 1930. Although there are indications of an upward trend, exports now fluctuate at a level well below that of the period from 1912 to 1930.

Figures in regard to the physical volume of exports of coconuts and coconut products mean little from the 1940's on. Due to the destruction of the 1944 hurricane and to the world shortage of fats and oils the policy in regard to coconut exports changed materially. The index reflects this (Table 1).

Coffee's physical volume index shows that exports were highest about the turn of the century and slumped from 144 in 1902 to 69 in (Table 1) 1904. Spasmodic increases have occurred, as from 1910 to 1918, but the trend has been continuously downwards and the volume of exports in 1952 was less than a third of that in 1939.

Ginger exports fluctuate markedly but were higher in the period 1944-1947 than in any other similar series of years (Table 1). Since 1947 the index has fluctuated on a somewhat lower level.

The index (Table 1) of citrus includes oranges (bitter and sweet), grapefruits, limes, tangerines, ugli's, lemons, juices, oils, skins, peels, pulp, canned fruit, marmalade. The composite figure for citrus and citrus products indicates that the physical volume of exports of the industry was relatively high in 1896 and 1898 (indices: 117 and 115). Orange exports declined sharply and steadily from the early years of the century and in the 1930's were only about one tenth of those in 1910. In the 1930's exports of orange juice began to appear. By 1935 the industry showed marked signs of revival and the physical volume of exports was higher in 1948 to 1950 than in any previous period of its history. The decline since 1950 is associated with the hurricane in 1951; the exports of fresh oranges in 1951-1952 were about one quarter those in 1950 and the 1951-1952 orange juice figure was about half that in 1950.

The manufacture and export of citrus products—canned orange juice, canned grapefruit and grapefruit juice, marmalade—has notably increased in the period of the 1940's and 1950's.

The composite figure for pimento and pimento products shows that pimento exports were highest from about 1894 to 1914 and again moved upwards after the first world war. While exports once more rose after the second world war they were substantially lower than in the earlier years of the century.

The physical volume of exports of tobacco increased more spectacularly than that of any other commodity considered. The index in



1952 was 909 (compared with a 100 in 1939) but was low in relation to the 1947 peak of 2319 (Table 1).

The exports of logwood and logwood products are now small compared with those in the years immediately before and close to the first world war (Table 1). Prior to 1895, only logwood was exported but from that year returns included logwood extracts. While at first the value of logwood was greater, by the early 1900's the value of logwood extracts was as great as that of logwood exports. With the outbreak of the 1914 war and with the emphasis on reduced shipping opportunities, logwood extracts increased in importance and from then on have, in general, formed a larger proportion of the exports than logwood. By the 1950's the exports consisted essentially of logwood extracts.

TABLE 5 RAINFALL IN JAMAICA

Month	Average rainfall for whole island (inches)
January	3.87
February	2.93
March	3.20
April	4.71
May	8.88
June	6.47
July	4.79
August	6.87
September	7.56
October	10.34
November	8.06
December	5.08
Total	72.76
Period	1870-1939

#### *Prices and relative proportion of exports*

In this study long-term trends of primary relevance are those dealing with the background and relative importance in the Jamaica economy of different industries. Data on the proportion of the island's total exports contributed by certain major enterprises are shown from the latter part of the last century to the present time (Table 2). Immediately before 1873 sugar and its by-products were responsible for some 60-70 per cent of the island's exports. At this time coffee was next in

importance in the exports and made up between 15 and 20 per cent. After the depression, sugar, with prices moving against it, declined relatively and by 1878 was about 46 per cent of exports while coffee had risen to 19 per cent. By the late 1870's pimento had begun to grow in importance and rose from 2 per cent in 1872 to 10 per cent in 1879.

The feature of the period, between 1880 and the end of the century, was the sharp increase in proportion of both bananas and logwood: bananas from 2 per cent in 1880 to 11 per cent in 1885 to 25 per cent in 1890 and to 36 per cent in 1900; logwood from 6 per cent in 1882 to over 20 per cent in the 1890's. The decline of sugar was equally notable, falling to between 10 and 20 per cent in the 1890's. This decrease seems all the more remarkable as the sugar exports expressed as a percentage of total exports did not fall in the period to lower than 70 per cent in British Guiana (much of the time it continued to be 96 to 99 per cent), only once as low as 80 per cent in Antigua and never lower than 95 per cent in Barbados. Jamaica by comparison had a diversified economy.

In the new century these broad relationships continued with sugar only 7 per cent of total exports at the outbreak of the first world war. Sugar prices had begun to move upward (Table 3; index of 89 in 1906 and 129 in 1911) but possibly because of the heavy capital commitments required for increased sugar production and also because banana prices were moving upward at an even faster rate, sugar production failed to respond to the increase in prices. Coffee too had declined relatively and contributed only about 6 per cent by 1913. Blue Mountain coffee had acquired a unique reputation for flavour and was grown originally entirely on estates so that the sharp fall in the relative importance of the exports was due essentially to soil erosion which reduced the output. In the years immediately preceding the war, coffee prices rose sharply (Table 3); the price index moved from 82 in 1906 to 131 in 1911.

In the period between the first and second world wars bananas continued to gain in importance and accounted for 60 per cent of exports in 1931 while sugar accounted for about 13 per cent of exports; coffee's relative importance remained at the low level to which it had fallen before the 1914-1918 war. Due primarily to the reasons indicated above, banana's importance decreased substantially after the second world war to about 18 per cent of exports in the three hurricane-free years, 1948-50, while sugar rose to over 50 per cent in the same period.

Tobacco expansion received its first major impetus between 1866 and 1873 when the then Governor thought it a 'scandal' that neither the British East nor West Indies were producing a good cigar although Manila and Havana were. The Government gave encouragement and the Cuban revolution in 1868 helped as refugees fled to Jamaica bringing with them the techniques and tradition of the cigar industry. The value of tobacco exports, about £1,000 in 1874, rose five years later to £10,000. By 1880 the commodity made up over 1 per cent of the island's exports. About this time the Collector of Taxes drew attention to "a

number of small manufactories of cigars" in addition to a fall in cigar imports from 7,000 lb. in 1871 to 2,000 lb. two years later. By 1879-80 it was stated officially that there was a steady demand for Jamaican cigars in England as well as in Europe.

There has been a marked fluctuation in the long-term trend of annual exports (quantity) of tobacco from Jamaica. From 1871-81 exports increased at the remarkable rate of 19 per cent a year of the average exports. In the following decade the trend was reversed with a decrease in exports of 9 per cent a year of the average exports. The movement then again changed its course and had a long upward sweep and for the next three decades, from 1890-1919, there was a steady advance at the rate of nearly 9 per cent a year of the average. For the following 20 years, 1919-1939, there was again the downward sweep and exports fell at the rate of nearly 9 per cent a year of the average. An indication of the decline is that cigar exports fell from 217,000 lb. in 1919 to 32,000 lb. in 1938. From 1939 there was an order of increase unprecedented in the industry's history. Exports rose steeply, from 30,000 lb. in 1939 to nearly 700,000 lb. in 1947, by which time the contribution to the Colony's visible exports was exceeded only by sugar, rum and bananas.

Information on price movements in the form of price indices (Tables 3 and 4) indicates trends which some export and domestic prices have taken. Of the commodities listed (Table 3) cocoa export prices relative to the prices of the other commodities have risen most but cocoa prices while rising so spectacularly in the 1940's and 1950's had shown a downward trend for the previous 30 years, the first world war years alone excepted. The high prices in recent years are a reflection not only of the world cocoa shortage but of careful local grading and of the influence of devaluation on prices received in Canada, the market for the bulk of the island's production.

Both coffee and ginger also had prices in 1952 which were substantially higher, relatively, than those of the other chief commodities under consideration. The two commodities with the lowest relative prices in the 1950's are rum and logwood.

The retail prices, in the domestic market, of a few food crops which are important in home consumption are expressed as indices with 1939 taken as the base period (Table 4). Of this group of commodities banana prices have risen the highest (an index of 728 in 1952 compared with a 1939 index of 100) on the home market. The unusually high price for bananas in the local market is to be explained mainly by the low prices which apparently prevailed in 1939 when, with the outbreak of war at the end of the year, shipments began to be curtailed and the increased supply in the local market lowered prices. The indices in Table 2 substantiate the argument that prices of bananas have not risen relatively higher than those of comparable commodities. The export prices of bananas, while higher than rum or logwood in 1952, are lower than the export prices of sugar or of any of the other commodities in the table.

## SOME ASPECTS OF SEASONAL VARIATION

In temperate countries the production of agricultural products has month to month changes in intimate response to the effects of the seasons. The differences between spring and winter are so evident that it is easy to understand their influences on activities in agriculture in particular: sowing of corn, farrowing of pigs, pasturing of cows. Even trapping of fur-bearing animals is affected by the relation between climate and breeding habits and this relationship in turn leads to closed seasons for game. The felling of timber requires certain conditions of temperature and moisture. This is in areas where the differences in seasons are pronounced and the inference is easy that under conditions as in Jamaica seasonal variation in activity is not marked.

The island's air temperature fluctuations are comparatively slight. The average range of the south coastal area is from 70° to 84°F. with February the coolest month and July the warmest. Temperatures are lower in the hills. The relative humidity is high in Kingston, ranging between 75 and 81 per cent and in the wetter districts approaching saturation point. Rainfall is a major factor. The precipitation is heaviest in the North-Eastern division of the island with an annual average rainfall of 96 inches and lightest in the Southern division with an annual average of 54 inches (Fig. 1). Two fairly well defined rainy seasons occur (Table 5): May to mid-June and mid-August to November, the latter with a more prolonged and heavier precipitation. The major dry season is December to April with February the driest month of the year, the shorter dry season from mid-June to mid-August. In the absence of extensive irrigation facilities the seasonal effect of rainfall is pronounced.

Mauldon (4), attempting to provide a conspectus of the normal seasonal variations in the use of labour in Australia, found that because of the paucity of the monthly data and the mixed character of the data when obtained, "estimates had to be built up on approximative hypotheses. For such estimates the claim to quantitative accuracy must be modest . . ." In Jamaica the figures available are even more limited in scope and continuity and it is possible to approximate seasonal activity in labour only by inference drawn from such information as is on record.

About 44 per cent of the total gainfully occupied population is employed in agriculture. Sugar is the most important single crop and makes up about 20 per cent of the value of total agricultural production, bananas about 7 per cent, the miscellaneous collection of crops known as root crops (which are used almost solely for internal consumption) about 22 per cent.

*Seasonal activity in sugar*

Cane has two distinct phases in its crop life, the growing and the ripening periods. Both are intimately affected by seasonal rainfall, especially in the areas not having irrigation supplies. Adequate moisture is important during the period of active growth and this is followed

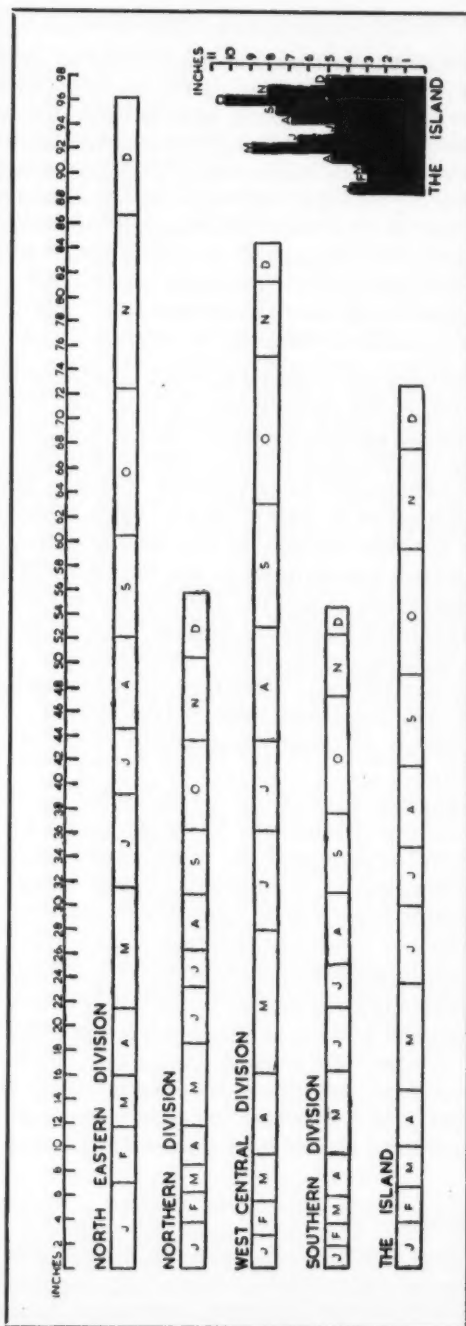


Figure 1. Rainfall in Jamaica

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by a maturing or ripening period associated with drier conditions. The traditional sequence is that cane sets or plants are put in the soil to take advantage of the rains. A period of reduced growth follows during the dry season with the most vigorous growth in the second rainy season (7). When the ripening period comes, in 14-18 months, vegetative growth falls off, sucrose content rises. High moisture in the soil at this period would encourage new growth, sprouting of buds, formation of roots and a resulting reduction of sucrose through inversion. In order to avoid such untoward developments, it can be of advantage to crowd the reaping into the dry months of the year before the May rains arrive to stimulate new growth and to complicate the problems of cane transport.

In Jamaica in recent years a trend away from the pattern of ending the grinding operations as early as April is appearing. One of the major factors responsible for the change is the rapid increase in cane acreage which makes it desirable to prolong the grinding season as an alternative to heavy capital investment in factory expansion. The normal five-year cycle (with one-fifth of the acreage replanted each year and four-fifths left in ratoons) is another influence. About three-quarters of the planting is done in the fall to take advantage of the August-September rains with about one-quarter in the spring for the May rains. The grinding starts in January on the canes which are then 15-18 months old. The factory, if its capacity is so great that it can grind its plant canes' quota in a month or less, can complete the corresponding acreage in first ratoon canes even more quickly since the first ratoon yield per acre is probably not more than three-quarters that of plant canes. The yields per acre get progressively lower in second, third and fourth ratoons and it necessarily follows that a factory with a given capacity can dispose of each successive fifth of the acreage correspondingly faster. In consequence the later ratoons have progressively less than a year's growth. At their late stage of development canes increase their yield by about one-third of a ton of sugar per acre per month's growth and it is profitable to ensure that the ratoons are reaped preferably at 12 or 13 months rather than at 11 months. The benefits of this sugar increment more than outweigh the disadvantages of the May rains and there are signs that the industry is consciously embarking on a policy of prolonging its grinding period to six or seven months of the year rather than limiting it to the three or four months before the May rains.

These relationships affect labour activity on the sugar estates as shown by the seasonal variation indices based on monthly total weights of canes ground by the island's industry (Table 6). While there is a small quantity of canes sometimes ground in December, factory operations do not really get under way until January and continue increasing in scale until in April more canes are ground than in any other month; the April index of canes ground is 254. By July grinding operations virtually come to an end; the June index: 104; the July index: 48.

In order to determine more definitely what are the effects on lab-

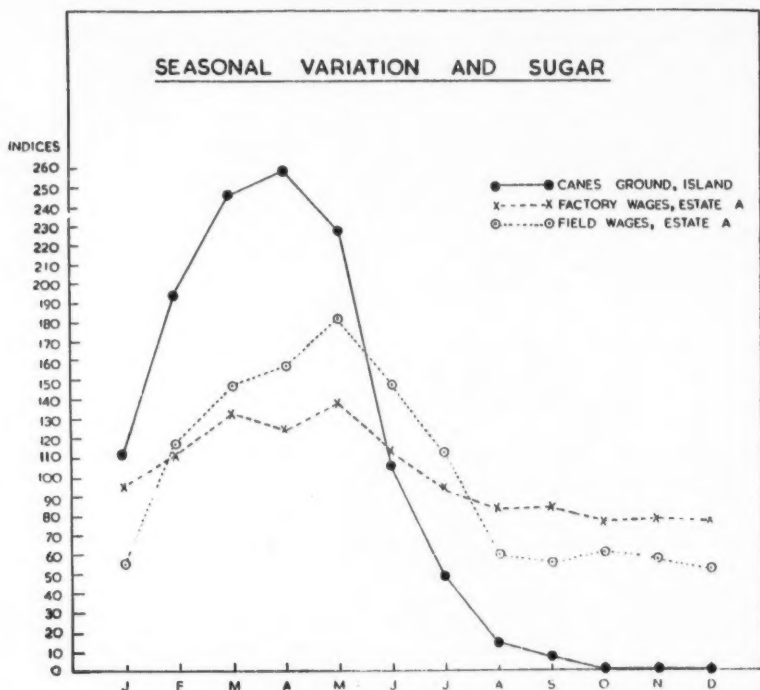


Figure 2. Different aspects of seasonal activity in the sugar industry

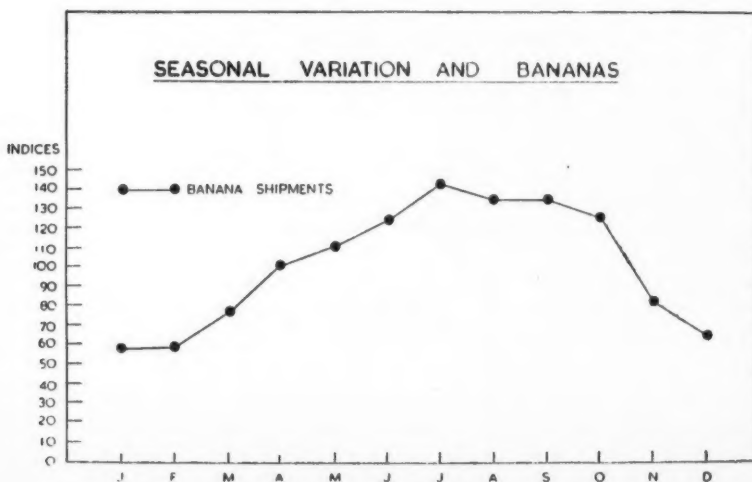


Figure 3. Seasonal activity in the banana industry as indicated by seasonal variation shipments

Month

January

February

March

April

May

June

July

August

September

October

November

December

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TABLE 6. ACTIVITY IN SUGAR

Month	Canes ground by sugar industry	Indices of Seasonal Variation			
		Total wages paid by sugar estate A		Total wages paid by sugar estate B	
		Factory workers	Field workers	Factory workers	Field workers
January	111	93	54	114	120
February	193	110	115	129	163
March	243	132	148	136	188
April	254	124	157	156	190
May	227	138	182	146	119
June	104	111	148	74	79
July	48	93	111	64	68
August	13	83	59	62	56
September	7	84	56	58	50
October	0	77	60	78	52
November	0	78	57	83	55
December	0	77	53	99	61
Period of Index	1938-48	1945-49	1945-49	1945-49	1945-49

our of these seasonal operations, one obvious statistic for study is the number of persons employed month by month in the sugar industry. The estates pay some of their labourers on a day rate basis and some on task rate which makes comparison of numbers of workers difficult. In addition, a job paid for on a task rate basis is often entered in the books in the name of one worker but performed by one or more. In the circumstances, total wages paid by the estate month by month provide a practical, even if not wholly satisfactory, means of reflecting the seasonal variation in employment on a sugar estate. Monthly indices of wages paid on two sugar estates—A with a longer grinding season and B with a shorter grinding season—show the order of variation (Table 6). These estates are selected because they are representative of the two policies now pursued in the island; they are located in the main sugar producing belt; they both record figures in a form that is consistent.

On estate A the employment as reflected in factory wages begins to rise in January but does not get to its highest level until March and this peak is maintained until May. May is the month with the highest factory wage figure on this estate. This is perhaps unexpected since, for the colony as a whole, the highest cane harvesting figure is in April but estate A has been increasing its output markedly in relation to the fixed capital embodied in factory equipment and shows the trend towards the prolonged grinding period referred to. Estate B does not show this trend so markedly and the peak of the factory employment is in April. The same type of relationship is maintained in the field operations of these two estates. In A, field employment rises more slowly, does not reach the peak until May and continues at a relatively high level until July. In B, field employment rises sharply from January and reaches its peak by April and is substantially less by May. For the

two factories pursuing the policies which are characteristic of the industry as a whole, field and factory employment is at a relatively high level for the four to five months, January to April-May and at a lower level for the seven to eight months, May-June to December.

Knowing the value of seasonal variation in employment both in the field and the factory one may reasonably surmise that the variation in employment would be less marked in the field than in the factory. Grinding continues for about half the year or less and, while factory machine maintenance and repairs must receive attention, the varied field operations would lead one to expect at least as high a level of continuity of employment among the field workers. On the contrary the index of employment as depicted by wages is appreciably lower on both estates in the off season (Table 6) for field workers than for factory workers. A higher percentage of field workers will have part-time work in other occupations including their own farms. If, however, the estates are maintaining higher employment in the factories during the off-season than is being used to full advantage—and these figures suggest the possibility—a longer grinding season where there is a choice should be given preference to factory expansion.

The nature of the seasonal variation in the activity of the sugar industry may be summarised as follows: seasonal variation in labour activity is marked (Fig. 2); greatest activity extends from January-February to April-May with a distinct trend towards prolonging the termination of the peak period from April-May to May-June; although the main factory operations last for only about half a year, there is more seasonal variation in total wages paid to field employees than in total wages paid to factory employees. Neumark (6) quotes interesting information about the seasonal requirements in certain other Caribbean territories. If the average weekly number employed on the estates out of the crop season in Antigua in 1946 was 100 the corresponding number employed during the crop season was 142; in 1947 the corresponding figures were 100 and 147. In Trinidad in 1937 the corresponding figures were 100 and 119.

#### *Seasonal activity in bananas*

In the banana crop the seasonal variation in activity is not marked. On the northern side of the island (where the rainfall is relatively heavy) and on the hill-sides the peak activity is traditionally from March to early May when operations connected with spring planting are under way. On the south coast where the August to November rains are not as heavy and where more of the bananas are grown under irrigation the pattern of activity is somewhat different. An illustration of this is the figures (Table 7) on wages for the banana enterprise of a sugar estate on the south coast where irrigation is available. These figures do not necessarily reflect sensitively the seasonal variation on smaller farming units or even on units with bananas as the chief enterprise but are available in a form consistently maintained from month to month over some years. The information (Table 7) indicates highest activity

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TABLE 7. ACTIVITY IN BANANAS

Indices of Seasonal Variation			Indices of Seasonal Variation		
Month	Wages in banana en- terprise on a sugar estate on the south coast	Total ship- ment of bananas (Quantity)	Month	Wages in banana en- terprise on a sugar estate on the south coast	Total ship- ment of bananas (Quantity)
January	113	56	July	98	141
February	96	58	August	87	135
March	107	76	September	80	135
April	73	100	October	114	125
May	93	110	November	144	79
June	99	123	December	95	62
Period of Index	1945-49	1919-38	Period of Index	1945-49	1919-38

from November to January. It is possible that, where bananas are in combination with sugar, banana activity is planned not to give the sugar labour demand more competition than necessary. This would reconcile the high banana activity on the sugar estate from November to January with the widely held opinion that banana peak activity is from March to May. The banana industry being in a stage of active change is another factor or some influence. In 1949 98 per cent of the crop was made up of the Gros Michel variety (which is susceptible to Panama Disease) and in 1953 only 48 per cent. The Lacatan variety is expanding and planting material is available more in the later than in the earlier months of the year.

Figures (Table 7) on exports provide a good basis for gauging reaping activities. 20 per cent of the crop reaped in the first quarter of the year, 25 per cent in the second, 30 per cent in the third, 25 per cent in the fourth is a rough working rule quoted by the industry. The indices of seasonal variation confirm that July to September is the peak shipment period with the highest index in July of 141.

In summary the relationships in the industry suggest the following conclusions: the contemporary period does not reflect satisfactorily the normal seasonal activities in the industry due mainly to the transition from one variety to another; the industry is not prone to as much seasonal variation in activity as many of the other agricultural enterprises of the island (Fig. 3); the normally expected peak of activity would be from March to May but, where irrigation is available, especially if sugar activities compete, the peak of activity in bananas will be pushed back in order not to interfere with sugar.

#### *Seasonal activity in provision crops*

Provision crops is an indefinite term used to cover a wide range of crops with the implication that ground provisions (i.e., root crops) play a major part in the collection. They are food crops, grown to some extent but not necessarily or even primarily for home consumption, and taken together are in money value the most important agricultural en-

terprises in the island. Root crops alone make up about 25 per cent of the total primary agricultural production.

Of the root crops yams, cocoes, sweet potatoes, potatoes (locally called Irish or English potatoes) are among the most important. Figures on general employment in these enterprises are unavailable. The only

TABLE 8. SEASONAL VARIATION IN PRICES OF SELECTED ROOT CROPS

Month	Indices of seasonal variation in Kingston market prices				
	Yams	Cocoas	Potatoes	Sweet Potatoes	Yampies
January	84	105	119	89	80
February	83	95	117	87	89
March	81	95	115	94	87
April	89	94	93	91	104
May	96	93	80	101	109
June	126	92	74	99	107
July	110	100	81	96	105
August	108	99	85	105	104
September	107	108	95	103	102
October	114	107	103	118	94
November	101	106	114	116	105
December	100	106	124	101	113
Period of Index	1940-48	1940-48	1940-48	1940-48	1940-48

discovered information, recorded month by month over a sufficiently long period, is the monthly market prices collected by the Government Bureau of Statistics. These figures provide, admittedly, a crude measure of activity within the different enterprises since prices can reflect not only supply but demand, and the inter-action of both, including possibilities of substitute products. Limited storage facilities, on the one hand, and pressure of need for cash sales, on the other, probably result in variations in prices giving a fair indication of times of arrival at market. With knowledge of seasonal arrival at market one can then work backwards with approximations of seasonal activity in the other operations relating to the production of the crops.

Yam arrivals on the market begin to make themselves felt by November and relatively low prices prevail until May (Table 8): a November price index falls to 101 compared with 114 in October. Yams, an 8 or 9 months crop, are put into the ground mainly from February to April. This active phase of preparation of the land, planting and the later major weeding from May to July, coincides with the harvesting and highest season of employment in sugar.

Yampies arrive on the market about the same time as yams but possibly because the crop is a much smaller one and the vegetable somewhat of a delicacy the lower level of prices lasts for a shorter period than with yams and extends only from January to March. The farmers have a tendency to hold the crop longer before harvesting and prices fall

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labour demand it is not of major importance; it is a tree crop and little is done throughout the year other than to pick the fruit but its supply in the July-September period is an important factor in the food price relationships; being relatively widespread and available it plays a part in meeting the carbohydrate needs at a time when most of the other competing items are in shorter supply.

Ackees, also a tree crop and also with little effect on the agricultural labour demand situation, is in supply most of the year. Prices are lower from January to April (Table 9).

Mangoes, another tree crop, used as a fruit and not as a vegetable are eaten in such quantity that during the "mango season" the effect on the food supply situation is appreciable. Coming on the market in abundance from May to August when many of the staple foods are at the end of their main seasons, the mango plays an important part in keeping a check on the tendency of other food crops to rise in price during this period of shortest supplies. From the point of view of employment relationships, many of the active population are engaged at one time or another in picking mangoes from May to August but the true labour demand is probably far less than the apparent. The fruit ripens in the island's employment off-season and many more people are engaged in picking mangoes than are needed.

Corn is planted twice a year. The chief activity with planting is from February to April. A low level of prices prevails in August to September (June index: 115, August index: 97). The lower indices in February and March (Table 9) reflect the arrival at market of the crop planted in the second half of the year.

Of the peas and beans, red peas are the most extensively cultivated for human consumption. The crop is sown in February to April and harvested from April to July. Another planting takes place in August but heavy losses have tended to discourage this. Prices are lowest in July-August but the price variation (Table 9) is not great.

Gungo peas, planted annually in August because of their reputation for drought resistance, arrive on the market in sufficient quantity for prices to be lower from February to May. Prices move upwards during July and August in the improved price trend characteristic of the latter half of the year. By comparison with red peas, gungo peas remain at a lower level of prices longer (Table 9).

#### *Seasonal activity in orchard crops*

Data on prices of two orchard crops, oranges and coffee, give an indication of harvesting seasonal activity in these enterprises (Table 10). Orange prices begin to fall by October, continue falling and, by January-February, are at their lowest. The figures suggest that the peak market arrivals are from December to February. Following on this are some of the main cultivation operations and the period December-March is probably the season of greatest labour activity. The arrival of coffee on the market begins a month or two later than that of oranges (Table 10)

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TABLE 10. SEASONAL VARIATION IN PRICES OF TWO ORCHARD CROPS

Month	Indices of seasonal variation in Kingston market prices		Month	Indices of seasonal variation in Kingston market prices	
	Coffee	Oranges		Coffee	Oranges
January	96	61	July	99	139
February	96	66	August	104	138
March	97	81	September	105	111
April	96	96	October	104	96
May	101	119	November	103	88
June	107	132	December	92	72
Period of Index	1940-48	1940-48	Period of Index	1940-48	1940-48

but the peaks of harvesting activity of the two crops, roughly, coincide. Coffee price indices are lowest from December to April.

The indication of labour activity chosen in coconuts is not market price quotations, but figures on copra market arrivals which are available and have a simpler, more direct relationship (Table 11). Increased copra deliveries to the oil processing industry begin in January but the peak of the season is from March to May. May is the month of highest deliveries with an index of 142. In these three major orchard crops the greatest activity is in the period, roughly, December to May.

#### *Seasonal activity in tobacco*

Tobacco is grown in the main in one clearly defined area on the south of the island. It is sown in the nurseries usually in August. Much of the success of a crop depends on whether or not the farmer gets his nursery established early enough for the seedlings to be planted out in the field before the November rains have gone. The plants when about 2½ ft. high are topped and the removal of the side shoots gives rise to much activity. About three months after the plants are transplanted to the field the crop is harvested. Soon after the reaping another weeding is given and the process of topping and suckering repeated. A ratoon crop is normally harvested about 2 months after the first crop is reaped. Much of the seasonal activity with tobacco is, therefore, from January to April and coincides with the sugar peak demand but there are also major employment opportunities about August.

#### *Seasonal activity in livestock and fish*

Figures are available on the livestock slaughtered month by month in the Kingston area and cover beef, mutton, pork. Of these items beef makes up the major part and is more important than either as far as labour requirements are concerned. Heaviest slaughtering takes place from November to January (Table 11): an index of 145 in December compared with 94 in October. The exceptionally high figure for December is associated with the Christmas demand but the supply of forage is a major influence. Grass growth begins with the May showers, continues, and is helped by the August to November rains. By December grass supplies are diminishing sharply and five months of

TABLE 11. SEASONAL VARIATION IN MARKET ARRIVALS

Month	Indices of Seasonal variation		Livestock (weight) slaughtered in Kingston
	Copra (weight) arrivals at market	Milk.(weight) arrivals at condensery	
January	111	84	111
February	99	72	103
March	127	75	99
April	119	74	85
May	142	89	89
June	96	118	78
July	98	132	86
August	91	125	105
September	76	114	95
October	79	116	94
November	66	107	111
December	96	96	145
Period of Index	1943- 48	1943- 48	1943- 47

sustained dry weather make the position worse. In the absence of irrigation heavy slaughtering by November-December is a wise precaution. Cattle which begin to fatten, after good grazing conditions are revived by the end of May or early June, require about five or six months to come into condition. Some agricultural specialists contend that the effect of the dry months, December to April, on the limitation of fodder is in many ways comparable with that of winter in a temperate climate. The indications are that the seasonal variation in the labour requirements of the beef industry is not great and that the heaviest demands are in the first half of the year, before and after the May rains.

The monthly receipts of milk at the condensery throw some light on seasonal variation in activity in dairying (Table 11). Milk receipts are low from December to May, rise and remain at a higher level from June to November, with July and August the peak months. Much of the milk is produced by small farms (to an increasing extent) and without benefit of irrigation. Under these conditions high milk production follows the burst of growth of forage crops after the May rains. The dairying industry like other livestock enterprises has a more even demand for labour than most crop production. Despite the higher milk output of the June to November period the problems of shortage of fodder followed by pasture maintenance and related operations from December to May have an equalizing effect on labour demand.

The only available figures on poultry relate to prices of eggs (Table 12). Prices rise to a higher level in August and get to their maximum in November-December. The sharp rise in November-December is due to some extent to Christmas baking but even without the seasonal demand prices in the latter half of the year might be higher because of the lower egg production associated with moulting. With the lack

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of a locally grown grain in sufficient quantity, the poultry industry on an organised basis is not large and seasonal variation in labour requirements is not important.

Fishing plays a part in meeting the island's protein requirements. The variation in labour requirements is not high. Prices of fish do not change markedly from month to month but a higher level of prices rules

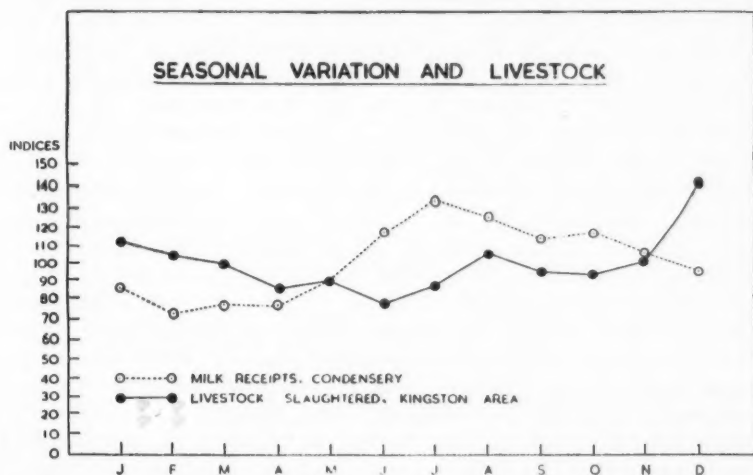


Figure 4. Seasonal activity in livestock as indicated by slaughtering

from November to May with fluctuations on a somewhat lower plane from June to October (Table 12). The higher prices may be associated with the gusty winds beginning about February which make fishing more difficult with a resulting curtailment of supplies. The wind is not the whole explanation because the figures on wind normals indicate that wind speeds are highest from February with the highest speeds in May, June and July; by June the index of fish prices has fallen. On the other

TABLE 12. SEASONAL VARIATION IN PRICES OF EGGS AND FISH

Month	Indices of seasonal variation in Kingston market prices		Month	Indices of seasonal variation in Kingston market prices	
	Eggs	Fish		Eggs	Fish
January	92	100	July	91	91
February	77	105	August	94	97
March	73	107	September	104	100
April	77	102	October	128	91
May	83	101	November	149	110
June	91	96	December	140	100
Period of Index	1940-48	1940-48	Period of Index	1940-48	1940-48

hand Brennan (1) draws attention to 'northers' which extend over large areas of land and sea affecting even navigation at times. These 'northers' occur usually from November to February and have decreased in frequency by June.

#### *Miscellaneous activity*

The Government Savings Bank has branches associated with post offices throughout the island and is the most widely used organisation providing banking services in the rural areas. The banks also serve the urban areas and no clear picture emerges from an examination of total withdrawals (Table 13). Heaviest withdrawals take place from November to January (Table 13) and are understandable in the context of the Christmas festivities but it is also apparent that, for the island as a whole, the end of the year is a difficult season because of the generally reduced opportunities for employment. Another rise in withdrawals takes place in July. By this time sugar and other major agricultural activities have reduced their employment opportunities. Domestic food crops are scarcer and demands have arisen for August planting preparations. Withdrawals are lowest in February and March.

The figures of registration at the Kingston Employment Bureau, which is associated with the Government Labour Department, were examined to determine whether these might provide a type of general index of seasonal variation in employment. A study of the data shows that there are various conflicting influences determining registration at the Bureau and that the figures are of doubtful value in reflecting the true employment or unemployment status of the corporate area or the island as a whole.

In order to determine whether high and low employment opportunity is reflected in the incidence of crimes like burglary indices of seasonal variation of crimes, reported to the Half-Way-Tree police station in the corporate area, are computed (Table 14). Data of this

TABLE 13. SEASONAL VARIATION IN BANKING

Month	Indices of seasonal variation withdrawals from savings banks	Month	Indices of seasonal variation withdrawals from savings banks
January	114	July	106
February	84	August	99
March	85	September	91
April	94	October	90
May	99	November	104
June	97	December	137
Period of Index	1945-49	Period of Index	1945-49

kind cannot be easily obtained and are not often kept in a consistent enough manner over a long enough period to permit monthly comparisons. Changes in the phrasing of a law or the transfer of a police

officer figures restrict Crimes and law somewhat is a free area at cation opportu breaking of peak Februar time fr 93 (Ta tablish urban correct agricul ployed

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officer may alter groupings or change the type of statistics kept. The figures shown (Table 14) refer to a somewhat limited period and a restricted area but were recorded in such a manner as to be comparable. Crimes in the Half-Way-Tree Police District like burglary, shopbreaking and larceny from a dwelling, increase from May until August and are somewhat higher than usual even down to November-December. There is a frequently expressed opinion that crimes are highest in the city area at Christmas time. The indices do not confirm this. The indication is that during the season of "hard" times when the employment opportunities are low, crimes such as burglary, housebreaking and shopbreaking are at their maximum. From January to April, the period of peak labour activity, these crimes are at a much lower level (a February index of 80 compared with an August index of 110). At no time from January to April does the index for these crimes rise above 93 (Table 14). Although Half-Way-Tree is urban there is a well established tradition of migration of the unemployed from the rural to the urban centres. These figures would have meaning if this assumption is correct—that the unemployment in this urban area is higher in the agricultural 'off-season' because of the migration of the rural unemployed in search of work which they do not find.

TABLE 14. SEASONAL VARIATION IN CRIMES (BURGLARY, SHOPBREAKING, LARCENY FROM DWELLING) REPORTED AT ONE POLICE STATION

Month	Indices of seasonal variation of crimes	Month	Indices of seasonal variation of crimes
January	84	July	109
February	80	August	110
March	90	September	103
April	93	October	106
May	108	November	102
June	116	December	100
Period of Index	1946-50	Period of Index	1946-50

#### DISCUSSION

In a study of economic development in most of the Caribbean territories much depends on the evaluation of the employment status in agriculture. One may even go so far as to say that that is the initial question to be answered. An example of the modification in policy which results from the different answers to the question is provided by the island of Hispaniola. The island is now divided into two parts: the Dominican Republic and Haiti. The Dominican Republic with about two-thirds of the total area of the island has only two-fifths of the total population; the population pressure is about 120 to the square mile. On the other hand Haiti, which has a much larger proportion of its land too mountainous to be arable, has one-third of the total land area with three-fifths of the total population; the population pressure is about 350 to the square mile. The vigorous expansion of agricultural

development is associated in the Dominican Republic with full employment and there is actually a shortage of labour with a standard of living that is by comparison high. Employment opportunities in agriculture and its ancillary activities place the Dominican Republic for comparison more suitably with New Zealand (with the important difference that New Zealand with a population pressure only one seventh that of the Dominican Republic has as many employees in secondary industries as in agriculture) than with Haiti. In other words in the Dominican Republic the land available for agricultural production permits a relatively high standard of living for the population in comparison with that in Haiti the unemployment and underemployment problem is of quite a different order from that in Haiti. The high population pressure relationships in Jamaica (312 to the square mile) more nearly approximate Haiti's than the Dominican Republic's. If one wishes to make an appraisal of the order of unemployment it is necessary in a situation like Jamaica's to take cognizance of the net effect of seasonal variation on employment.

Much of the data in this paper only indirectly reflects the employment opportunities and is only indicative, but the general picture, though blurred is distinct enough to outline the structure of unemployment and more particularly of underemployment in the main sector of the island's economy. Indices of seasonal variation relating to various activities have been constructed. The link-relative method is used except in a few cases when (e.g., in canes ground) there are no activities whatever in certain months of the year. The seasonal influences which in Jamaica largely revolve around rainfall are disparate in effect but from these indices a degree of concentration in seasonal agricultural activity has emerged that was not anticipated. The conclusions to be drawn from these figures must be qualitative rather than quantitative in nature, but it is clear that the order of employment opportunity in the early months of the year—roughly December to July—is much greater than that in the other period of the year—roughly August to November. In a community with the population pressure of Jamaica, which suffers from excess labour in agriculture, the underemployment from August to November must indeed be massive.

The factors of primary concern in this analysis are two: the demand for labour (in the form of employment opportunities) and the supply of labour. The inter-relationships of these two activities (labour supply and demand) are influenced by seasonal factors. The problem is to determine how the necessary similarity in the rate of the two activities can be attained or what can be done in order to avoid at least the undesirable effects of dissimilarity in these rates (3). There are various approaches which one may make, separately or together, in trying to lessen the undesirable effects of dissimilarity in these rates caused by seasonal variation in economic activity.

(a) *Change of rate of one activity.*

If the rate of one of the two inter-related activities can be changed

in the right direction it becomes possible to lessen the disparity in seasonal influences on the two activities. The sugar industry is providing an illustration of the type of change which can take place, by intent or by force of circumstances. The crop is basically prone to marked seasonal activity. Peak employment occurs during the period of the working of the factory when there are milling, harvesting and planting operations. Traditionally, this period has been restricted to about 12-15 weeks in the early months of the year, with its end defined more or less firmly by the May rains. With the decline of bananas on the one hand and the vigorous encouragement of expansion of sugar by the second world war, cane acreage expanded. Adequate facilities for milling then became a problem which could be solved either by increasing factory capacity by capital investment or by extending the grinding period. Both courses are being followed but partly because of unavailability of free capital in the industry the capital investment in factory expansion has not been pursued as vigorously as might have been done in other circumstances. The alternative, the prolonging of the milling period, is now being explored throughout the industry and is likely to affect the pattern of seasonal variation of employment in sugar.

Increased water control may also modify the rate of activity in some spheres of agriculture. The point has been made that rainfall is a major influence on agricultural activity. There are some 80,000 acres of land that is worth irrigating (5). The International Bank's Mission has placed a good deal of emphasis on the need for a comprehensive hydrological survey and rightly so. While it is desirable to explore underground supplies it is also necessary to approach the problem of water resources including rainfall and catchment areas in the hills as one integrated undertaking with capital costs amortized not only by irrigation but also from hydro-electric power and flood control. Interesting schemes are in operation in the Artibonite Scheme in Haiti and in Puerto Rico. More extensive supplies of irrigation water would play a part in smoothing out some of the humps in seasonal variation of agricultural activity in Jamaica.

There is a concentration of agricultural activity in one season of the year roughly December to July. This derived or induced activity in so large a sector of the island's economy has led to a derived variation in the reaction to labour. During the months of low employment opportunities, in August to November when underemployment is probably more extensive than is often recognised, the induced or derived effect is for labour to offer itself on terms much less favourable than those which apply from December to July. This is a harsh but functional method of bringing seasonally low demand for labour into closer conformity with the relatively high supply of workers available. In this case the phase of activity which is less affected by the seasonal conditions (the agricultural labour supply) changes its rate of activity to conform to that phase of activity, agricultural production, more affected by seasonal conditions. It is not always the branch of activity, which is less affected

by the seasonal conditions, that changes. Thus in the tourist industry of Jamaica heavy bookings by visitors from abroad are associated with a sharp rise in hotel rates. During the summer months when the resorts are somewhat hotter, less heavy demands for hotel accommodation from abroad cause rates to fall substantially and an increasing number of local holiday folk patronize the resort hotels in the "off" season. The trend is in the direction of less marked seasonal variation in hotel activity.

(b) *Accumulation of stocks.*

Another method of smoothing out the effects of seasonal variation is the accumulation of stocks and later their gradual distribution. As Kuznets (3) points out this can be an effective method when the original seasonal disparity cannot be removed by other means. It is a method specially worth exploring in direct price relationships but the method is also of interest in relation to the disparities caused in employment through seasonal effects on agricultural activity. Fodder is a commodity that could be more extensively stored and marketed through stock in seasons when availability of food becomes a limiting factor in different phases of livestock activity.

Investment in storage facilities for farmers' produce (with emphasis on cool and cold storage) can encourage the accumulation of stocks and prolong certain phases of agricultural activity beyond their existing sharply defined seasonal limits. It is unlikely that much progress will be made with accumulation of stocks unless there is some credit to help the farmer tide over his cash demands. An authoritative estimate (5) is that the high seasonal need for production credit will, with bold development in Jamaica, approximate £3.5 million.

(c) *Seasonal migration*

Some of the internal migration which takes place in Jamaica is in response to seasonal demands. This doubtless helps to reduce seasonal unemployment in some areas although this cannot affect the island situation as a whole. Theoretically seasonal emigration of labour would be an effective solution of the main problem of seasonal variation in employment opportunities. In practice the problem remains since there are few emigration opportunities.

(d) *Complementary activity*

Another approach to reducing the disparity in primary seasonal influences upon agricultural activity and the sustained provision of employment opportunities is the introduction or expansion of complementary activity. This complementary activity must, of course, have a response to seasonal influences different in timing and intensity from those already characteristic of the island's economy.

Complementary activity can be produced by expanding the livestock industry, an enterprise which has a relatively even distribution of year-round labour requirements. Emphasis on mixed farming (i.e., involving livestock inclusion) is one of the most vigorously pursued directions of

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agricultural policy in the Caribbean since the recommendations of the 1938 Royal Commission. The Commission's emphasis on livestock expansion may in time be regarded as their single most significant contribution in the field of agriculture.

In the introduction of complementary activity the sugar industry provides examples in the manufacture of an increasing number of by-products including anhydrous alcohol, carbon dioxide, rum. It is feasible that this type of activity can and should be extended even further and faster but the industry shares a handicap with other similar organizations. The machinery, equipment and technicians servicing them are the results of specialization in limited spheres of activity. Management is no different. The head of a sugar plantation having risen to his post of influence, in most cases because of his agricultural expertness in growing two tons of cane where one grew before, may be only mildly enthusiastic when he and those for whom he has responsibility are asked to undertake the speculative venture of extracting cane wax. This lack of enthusiasm is not restricted to the manager. He is a part of a hierarchy experienced in marketing and distributing sugar. Wax and sugar do not melt at the same temperature and this may lead to storage or transport complications. The distribution channels for rum and wax are different. The entrepreneurial talent which is available to most modern industries, needing a high degree of specialization if they are to survive, does not make expansion into new manufactures and new markets easy.

Nevertheless, the problems of seasonal variation in employment opportunities affect the island as a whole and strategic inducements for more by-product activity are indicated. There are industries other than sugar which are processing agricultural products and thus making their contribution to solving the seasonal unemployment problem. These include coconuts, citrus, tomato, tobacco products.

There is an increasing number of industries which are not dependent on locally produced agricultural raw products, for example cement and textiles. The employment which these provide is equally effective in meeting the problems of seasonal demand for labour. The extension of industries based on agricultural or on other raw products is one of the ways of providing activity complementary to that of the present major seasonal industries.

#### CONCLUSIONS

This paper has its origin in a study of economic development of Jamaica. In the literature more and more discussion is centering on what is meant by economic development. Viner (8) observes that in current literature the common criteria of 'underdevelopment' are:

- (1) a low ratio of population to area;
- (2) a scarcity of capital as shown by high interest rates;
- (3) a low ratio of industrial output to total output or of industrial population to total population;

- (4) a 'young' country;
- (5) good potential prospects for the use of more capital, or more labour, or more available natural resources to raise the level of living of the present population; if the level of per capita incomes is already high the purpose may be to support a larger population on a level of living which does not fall.

Of these various criteria Viner considers the fifth "the more useful!" Accepting his judgment one must conclude that 'good potential prospects' for the use of more labour will apply to those territories where 'more labour' is already available and present. This condition obtains in a large proportion of the world's economically underdeveloped territories including Jamaica. An initial step in a study in the field therefore necessarily involves an appraisal of the labour and natural resources.

Appraisal of labour resources in Jamaica, or expressed less euphemistically, appraisal of the degree of unemployment or underemployment, is in this study approached from the point of view of seasonal variation implications for the problem. Indices of seasonal variation have been computed in a number of instances. Admittedly much of the data does not directly reflect the employment opportunities and is only indicative. Nevertheless there is a fairly distinct picture of the qualitative nature of unemployment and more particularly of underemployment in the main sector of the island's economy.

The interpretation of the indices is that as a net result, especially from August to November, underemployment must indeed be massive in the agricultural sector of the economy.

The last part of the paper discusses, under four heads, approaches which one may make, separately or together, in trying to lessen the undesirable effects of dissimilarity in rates of activity associated with seasonal effects. The four heads are: change of rate of one activity; accumulation of stocks; seasonal migration; complementary activity. Of these the first and the last seem to offer most promise. Active expansion of agriculture including increased water control can modify the rate of activity in some spheres of agriculture. The effects of rapid expansion on sugar policy is one of the promising aspects of improvement in seasonal activity. Sugar is the main agricultural industry and because of several factors, to which attention is drawn, the industry is prolonging its milling operations over a longer period than is traditional.

The last, complementary activity, is another important head and is, clearly, a direction in which a major part of the contribution must be made in meeting the problem of seasonal variation in activity.

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## ACKNOWLEDGEMENT

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# ORIGINAL ARTICLES

1. The Effect of the Diet on the Metabolism of the Human Body. By J. W. Mellor, M.D., and J. H. M. Taylor, M.D., University of California, Berkeley, California.

## THE DIET

The diet of the human body is a subject of great importance, and one which has been the subject of much investigation. The diet of the human body is a subject of great importance, and one which has been the subject of much investigation. The diet of the human body is a subject of great importance, and one which has been the subject of much investigation.

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